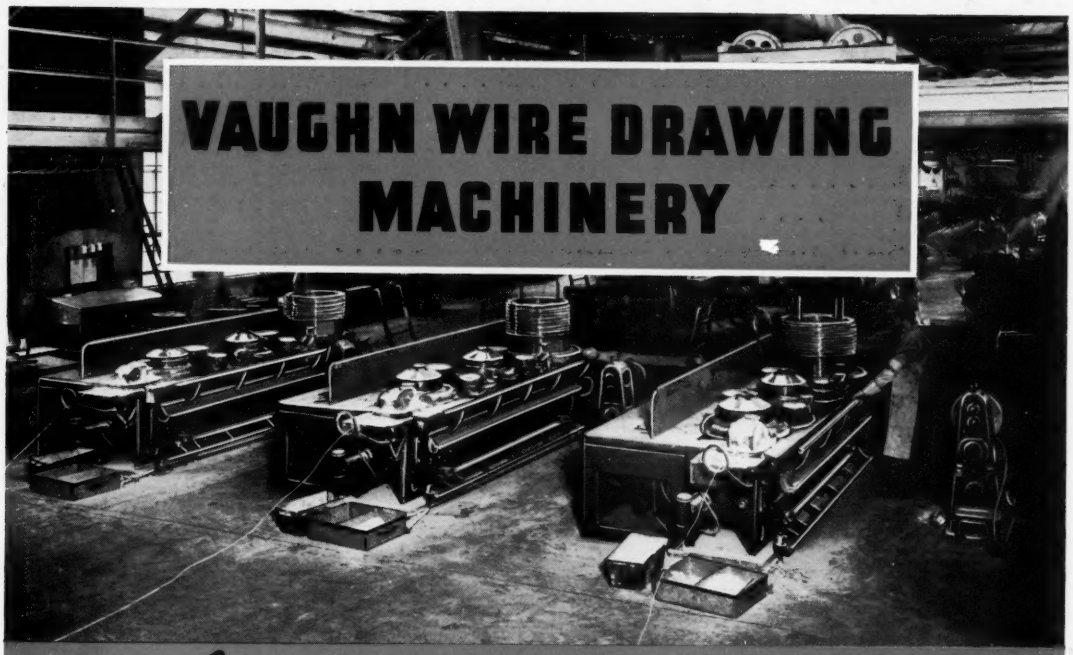
NOVEMBER 1936

WIRE AND WIRE PRODUCTS



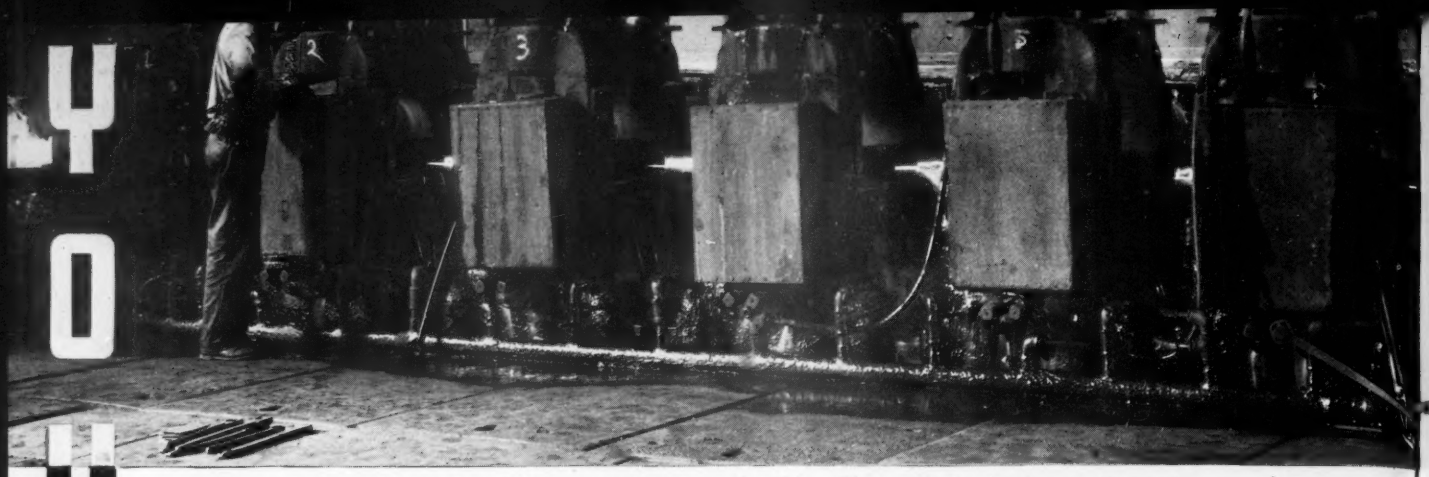
In the picture, but invisible

Back of each Vaughn Machine stand the years of specialized experience that developed and refined it; the capable engineering service that fitted it into the production scheme like a hand in a glove . . . values that, although themselves intangible, *produce visible and tangible results!*

THE VAUGHN MACHINERY COMPANY
CUYAHOGA FALLS, OHIO

Complete Drawing Equipment—Continuous or Single Hole . . . For the Largest Bars —for the Smallest Wire . . . Ferrous, Non-Ferrous Materials or their Alloys

OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION



Roughing stands in a continuous rod mill rolling rods to be drawn into wire

★IF NO ONE OF THESE WIRES LISTED BELOW MEETS YOUR PARTICULAR REQUIREMENTS, LET US KNOW . . . . our metallurgists have proved themselves able to develop highly specialized wires for a wide variety of uses.

★ANNEALED WIRE . . . . BALE TIE WIRE . . . . BOLT WIRE . . . . BOX BINDING WIRE . . . . BRIGHT WIRE . . . . BUNDLING WIRE . . . . CHAIN WIRE . . . . CRIMPING WIRE . . . . COAT AND HAT HOOK WIRE . . . . COPPERED WIRE . . . . GALVANIZED WIRE . . . . GRAPE WIRE . . . . HIGH CARBON SPRING WIRE . . . . HINGE PIN WIRE . . . . LIME COATED WIRE . . . . LIQUOR COATED WIRE . . . . MACHINE SCREW WIRE . . . . MARKET WIRE . . . . NAIL WIRE . . . . NOGALD BOLT WIRE . . . . NUT WIRE . . . . PAIL BAIL WIRE . . . . RIM WIRE . . . . RIVET WIRE . . . . SAE HEADING WIRE . . . . SCREW WIRE . . . . SCREW DRIVER WIRE SPOKE WIRE . . . . STAPLING WIRE . . . . STRAIGHTENED AND CUT WIRE STRAND WIRE . . . . WELDING WIRE . . . . WOOL WIRE X-TRUDO BOLT WIRE . . . . YOLOY WIRE

THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of Carbon and Alloy Steels

General Offices - - YOUNGSTOWN, OHIO

SHEETS; PLATES; TUBULAR PRODUCTS; CONDUIT; TIN PLATE; BARS; RODS; WIRE; NAILS; UNIONS; TIE PLATES AND SPIKES

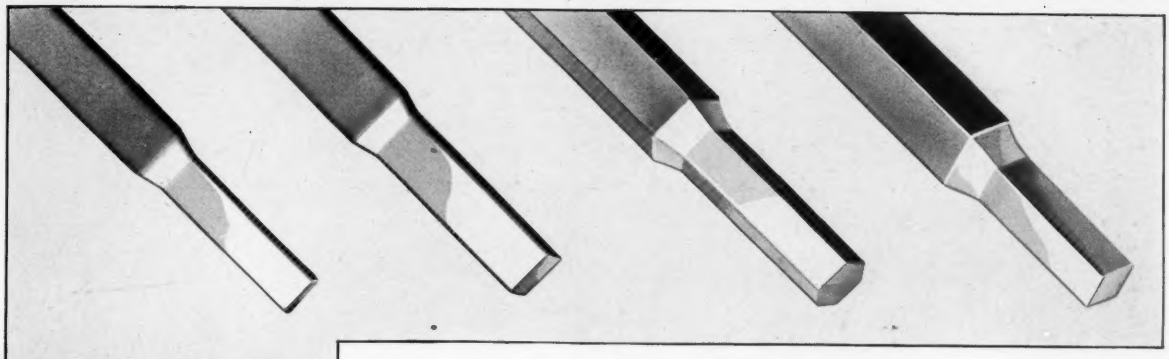
635

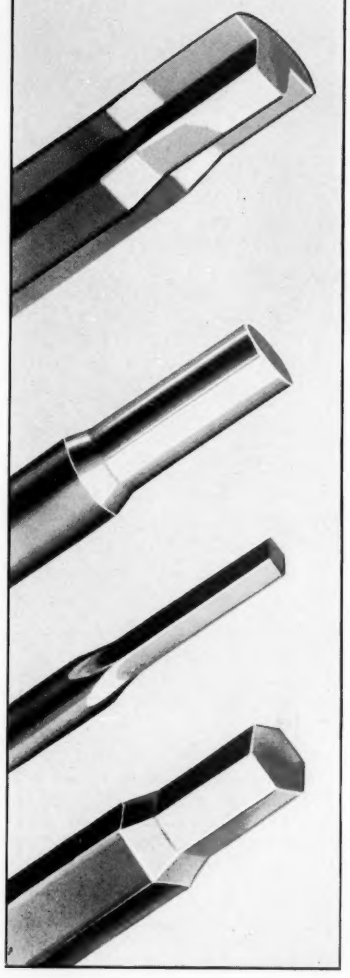
QUALITY TRADE MARK YOUNGSTOWN SERVICE

A battery of Youngstown wire drawing machines

YOUNGSTOWN

MANUFACTURERS' STEEL WIRE





Illustrated here are a few common applications of Carboloy Sectional Dies. All are steel except the square bar drawn from round stock. This application is on non-ferrous stock only.

The Mark of CARBOLOY

CARBOLOY SECTIONAL SHAPED DIES

Among the many applications of Carboloy dies which are now in economical use, the drawing of shaped stock is one on which the ability of Carboloy cemented carbide to effect closer limits, less scrap and better finish is particularly advantageous.

Carboloy ***Sectional*** Nibs are used for this type of work. These are available in all shapes and sizes for drawing steel or non-ferrous wire, rod or bar stock. Nibs may be re-worked to smaller, larger or original sizes as desired.

Your Carboloy representative will be glad to furnish further information on the use of Carboloy Sectional Dies for your shaped work.

CARBOLOY COMPANY, INC.

2985 E. Jefferson Ave., Detroit, Michigan

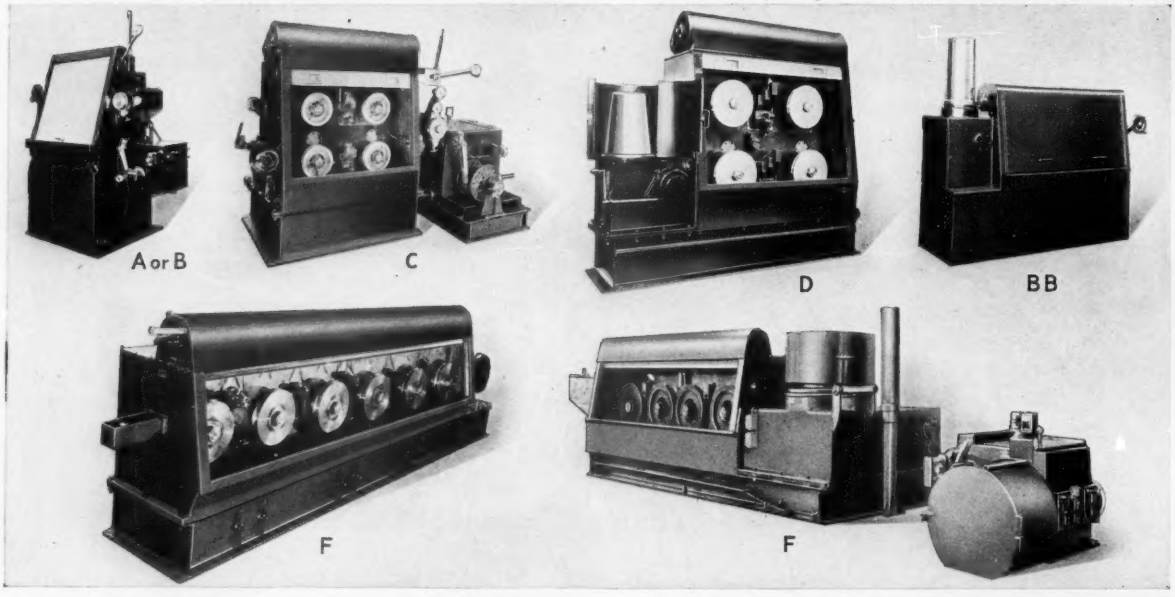
CHICAGO CLEVELAND NEWARK
PITTSBURGH PHILADELPHIA

Authorized Distributors:
Hartley Wire Die Co., Waterbury, Conn.
Canada: Canadian General Electric Co., Ltd., Toronto, Ontario

CARBOLOY REG. U.S. PAT. OFF. **DRAWING AND EXTRUSION DIES**

WIRE & WIRE PRODUCTS, Vol. 11, No. 11, November, 1936. Executive office, 17 East 42nd St., New York, N. Y. Published by the Quinn-Brown Publishing Corp., Richard E. Brown, President; R. S. Spengel, Secretary and Treasurer. Publication office, 13 West Church Street, Washington, N. J. Subscription price: U. S., $5.00; Canada, $5.00 per year, 50 cents per copy; Foreign, $7.50 per year. Entered as second class mail at the Post Office, Washington, N. J., under Act of March, 1879.

WIRE DRAWING EQUIPMENT



A complete line, minimum slip, wire drawing equipment built primarily for high speed wire drawing production. Liberal proportioning, anti-friction mounting, efficient power transmission, freedom from belts or chains, positive variable speed drive to spoolers to maintain uniform wire speed, accurate wire tension control at the point of spooling are a few of the features contributing to long life, efficient operation, economical production, clean and excellently wound quality wire.

Type of Machine	A	B	C	D	BB	F
With or without Spoolers	Yes	Yes	Yes	Yes	Yes	Yes
With or without Coiler	Yes	Yes	Yes	Yes	Yes	Yes
Size of finished wire B & S gauge	#34-#44	#26-34	#18-26	#12-22	#26-34	#2-#12
Number of Dies	16	16	12 or 13	13	13	5-7-9-11 or 13
Finished Wire Speed-FPM	5000	5000	4000	3500	2500 to 3500	2500 & 1000

High Speed Insulating Machines
For use with Paper — Cotton — Silk

Saturating and Finishing Equipment
For Weatherproof and Code Wire

Taping Machines for Cambric and Paper

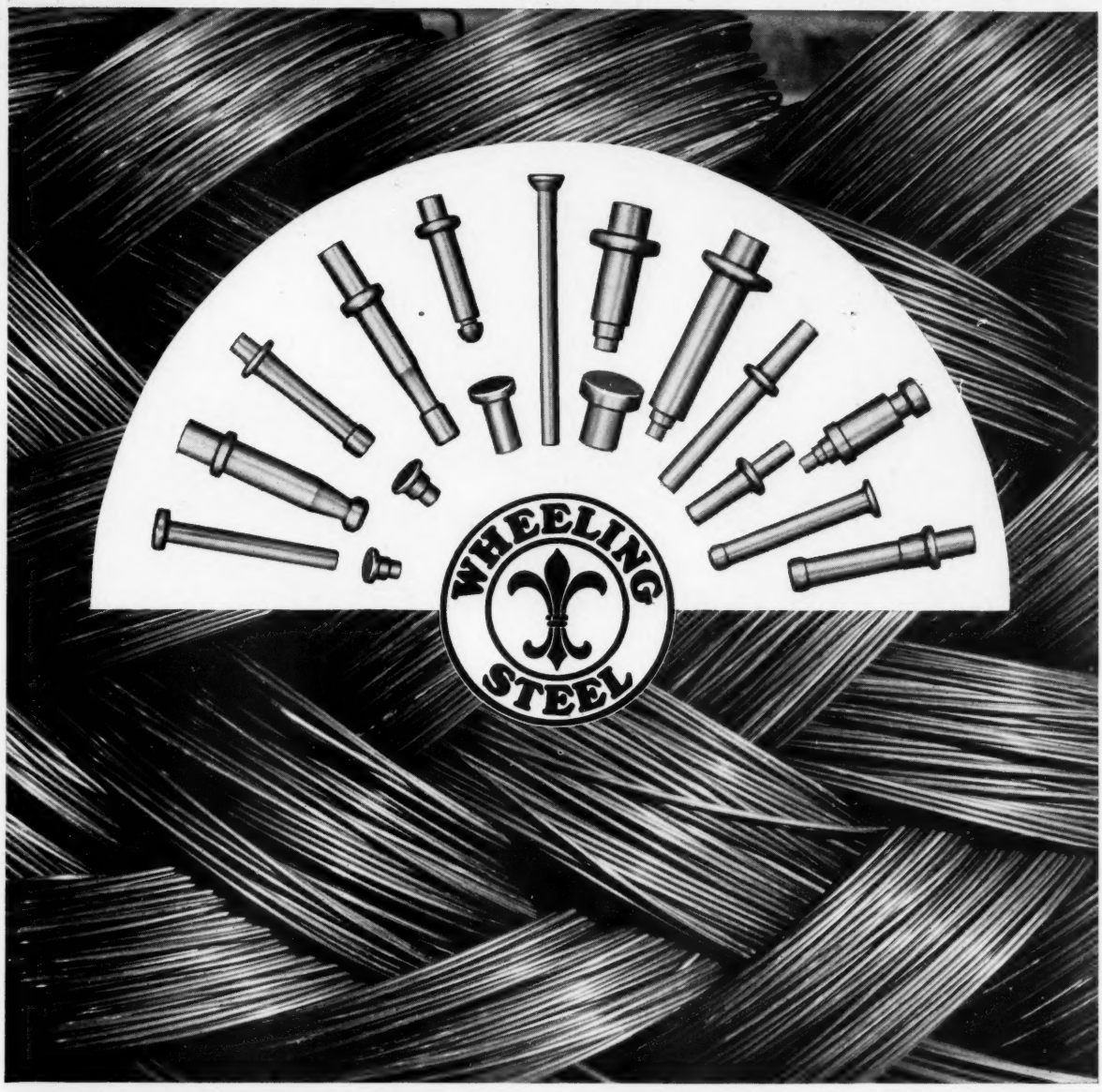
Take-ups — Spoolers — Coilers

Complete Tinning Equipment

Other Equipment for Producing
Wire and Cable

ELEVATOR SUPPLIES COMPANY, Inc.

HOBOKEN, N. J.



RODS *and* WIRE MADE OF WHEELING STEEL

COLD HEADING WIRE, BRIGHT, ANNEALED
AND GALVANIZED, STRAIGHTENED
AND CUT WIRE

WHEELING STEEL CORPORATION, WHEELING, WEST VA.

IT'S WHEELING STEEL

"HUDCO" PRODUCTS...
Specially Processed Copper Wire...

▲▲▲ Electrolytic and Oxygen Free ▲▲▲

WIRE---
ESPECIALLY MADE FOR METALLIZING

Pure Lead
Lead Alloy
Pure Zinc
Zinc Alloy
Copper
Tin
High Brass
Low Brass
Solder Wire
Cadmium
Nickel Silver (10%, 18%, 30%)
Aluminum
Monel Metal
Phosphor Bronze
Pure Nickel
Commercial Bronze

"HUDCO"
High Conductivity Electric Wire

✦ ✦ ✦

BRUSH WIRES, CRIMP and STRAIGHT
Brass, Steel, Nickel Silver, Copper and Phosphor Bronze

✦ ✦ ✦

TINSEL LAHNS
Silver Plated Copper, False Gold and Copper

✦ ✦ ✦

METALLIC FIBRE FOR PACKING PURPOSES
Copper, Bronze, Zinc, Lead and Aluminum

FINE BARE WIRES

High Brass
Low Brass
Zinc 99.99+ and High Tensile Zinc
Commercial Bronze
Phosphor Bronze
Pure Tin
Lead
Antimonial Lead
Cadmium
Nickel Silver, 10%, 18% and 30%
Silver Plated Copper
False Gold and Special Brass and Bronze Alloys to Specification

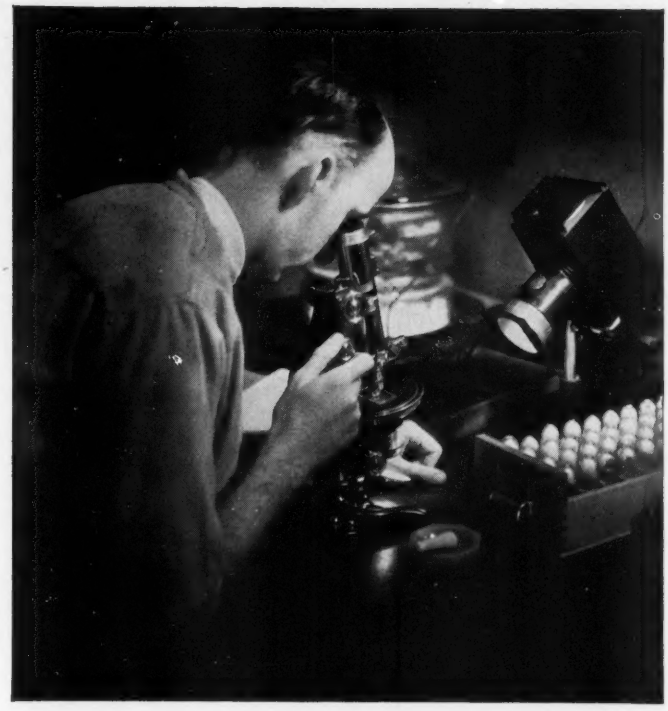
Winco PRODUCTS **Leakproof Enameled Wire**

and enameled wires in all Standard and Special Covering ▲▲▲
Made to meet the most exacting requirements ▲▲▲
THE WINSTED DIVISION OF HUDSON WIRE COMPANY, WINSTED, CONN.

We can serve you quickly and economically.
Send in your specifications for a quotation.

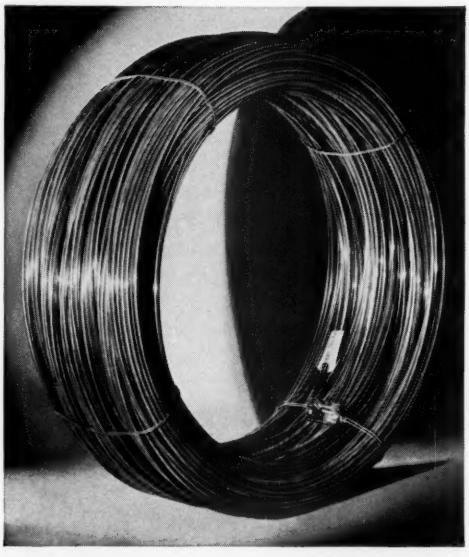
HUDSON WIRE COMPANY
Ossining, N. Y.

Estab. 1902 — Successors ROYLE & AKIN — Estab. 1902



You MAY NOT KNOW HIM

. . . BUT IF YOU USE REPUBLIC WIRE



HE KNOWS YOU. . . .

● Did you ever hear the name of Paul Revere's horse? Probably not, but it was the horse that made possible Revere's famous ride.

Likewise, you may never know any of the men behind the scenes in Republic's famous metallurgical laboratories—but they are at work day after day developing new steels and improving others—insuring unusually high uniformity in the properties required by the users.

Republic metallurgists are responsible to large extent for the high quality of Republic Wire. They know the needs of users—they know what the wire must do—and they know how to produce wire of the exact quality demanded.

If you are a user of Republic Wire, these men have a complete record of your requirements and make absolutely certain before shipment that the wire will be satisfactory in every detail. If you have never used Republic Wire, it will be to your advantage in many ways to become acquainted with the quality and service which awaits your inquiry and order. If you have a particularly difficult wire problem, put it up to Republic's metallurgists—you'll find that their recommendations will help to improve your product, speed up production and cut costs.

Basic Open-Hearth and Bessemer (Annealed—Regular—Hard Drawn—Sul Coated—Bright—Extra Bright—Copper Coated—Liquor Finish—Galvanized)—Spring Wire—Enduro Stainless Steel Wire—Toncan Iron Wire—Cold Heading Wire—Wire Rods.

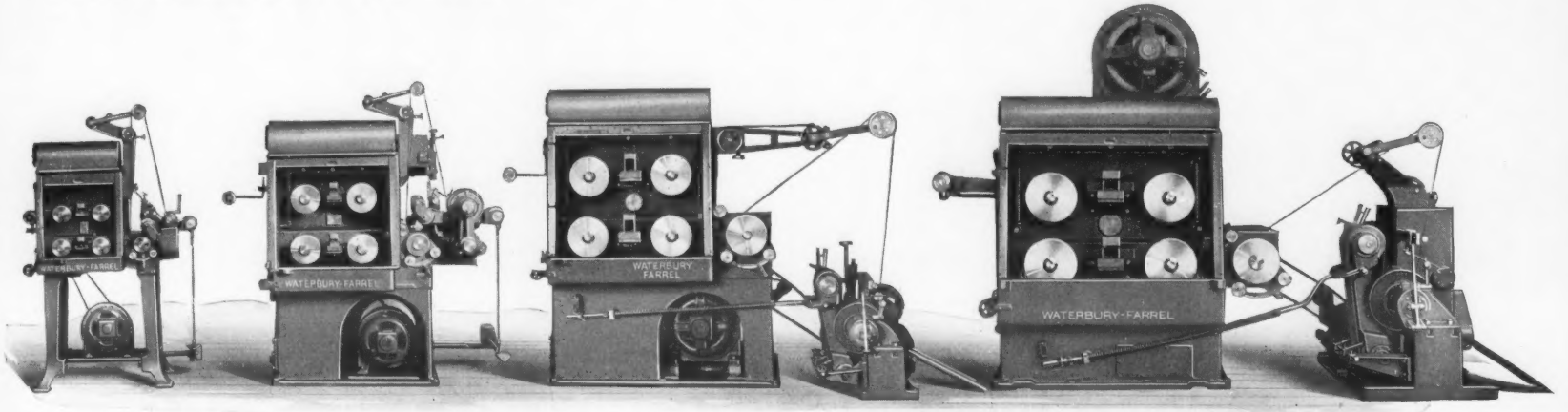
Republic Steel
CORPORATION

WIRE DIVISION . . . OFFICES AND PLANTS
7850 SOUTH CHICAGO AVENUE . . . CHICAGO, ILLINOIS
GENERAL OFFICES . . . CLEVELAND, OHIO

REPUBLIC STEEL

UPRIGHT CONE WIRE DRAWING MACHINES . . .

"A CLEANER WIRE AT LOWER COST;
A BETTER QUALITY AT HIGHER SPEED"



For Finishing Non-ferrous Wire at High Speed.
4 Sizes - - Block or Spool Type - - Low Maintenance.
Write for Catalogue W on Wire Machinery.

. . HIGH SPEED AND QUALITY

Waterbury Farrel Foundry and Machine Company

WATERBURY, CONNECTICUT

CLEVELAND CHICAGO NEW YORK

● Into metallurgists' records, findings are being written which accelerate the trend away from the old methods for zinc-coating wire. With plans focused on future profits, wire mills are today installing modern electro-galvanizing units, in some cases at initial cost several times that of other processes. Selection of these Meaker electro units was clinched by tests too severe for any but Meaker coating to survive—tests that anticipate the requirements which wire makers will be called on to meet in the highly competitive years ahead.

Meaker invites inquiry on their perfected process for electro-galvanizing round wire, now in commercial operation.

MEAKER PROCESS *for*

ELECTRO-GALVANIZING ROUND WIRE

THE **MEAKER** CO.

1629-1641 SOUTH 55TH AVENUE

CHICAGO, ILLINOIS

Name Your Specifications

MR. MANUFACTURER

Here's a man who sees that you get exactly what you require

If he were on your own payroll, he could not be more conscientious and exacting in the inspection of wire for your order. "Hardboiled," responsible only to the mill executives, he fears to tread on no one's toes. Perfection is his hobby, uniformity an obsession. Such epithets as "Hairsplitter," "Crank," are compliments to him. The result is a degree of uniformity unheard of a few years ago in the steel industry. The services of our engineers in working out your wire problems are gladly offered. Please do not hesitate to consult us.

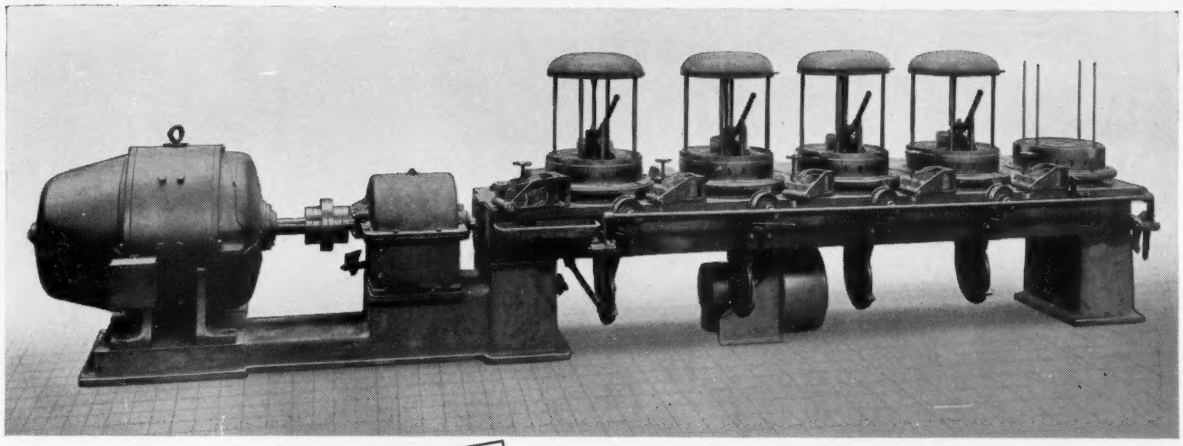
Pittsburgh Wires

FOR EVERY PURPOSE

PITTSBURGH STEEL COMPANY • 755 UNION TRUST BLDG. • PITTSBURGH, PA.

NEW YORK PHILADELPHIA SYRACUSE DETROIT CHICAGO ST. LOUIS MEMPHIS HOUSTON SAN FRANCISCO LOS ANGELES CHARLOTTE, N. C.

Spring Wire • Chain Wire • Box Binding Wire • Lavite Annealed Wire • Cold Heading Wire • Core Wire
Welding Wire • Spoke Wire • Bail Wire • Bolt Wire • Rivet Wire • Cap Screw Wire • Chaplet Wire
Nail Wire • Crimping Wire • Link Wire • Stapling Wire • Tack Wire • Spark Plug Wire



Morgan-Connor Continuous Wire Machine, Type B. Fully equipped with motor and control, air-cooling system, clutches and safety stops. Designed to start from commercial No. 5 rod in either high carbon or softer grades.

Coiled AND Cooled ..FOR *Greater* SPEED

An exclusive Morgan-Connor feature, the high block design, eliminates objectionable slip and permits proper cooling of the wire between dies. Naturally die wear is reduced, resulting in a more uniform product, at greater production speeds.

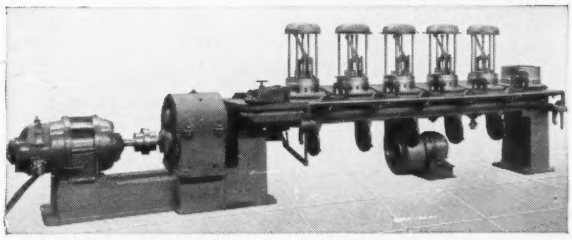
But these are only a few of the many distinct improvements incorporated in Morgan-Connor Continuous Wire Machines. Excess bulk is eliminated; floor space is saved; compact strength is manifest in every unit. A rugged flexibility coupled with lowered maintenance permits greater tonnage per unit—less cost per ton.

Safe, easy operation is a feature. An A. C. or adjustable speed D. C. motor can be supplied as desired. Adequate safety features protect the operator.

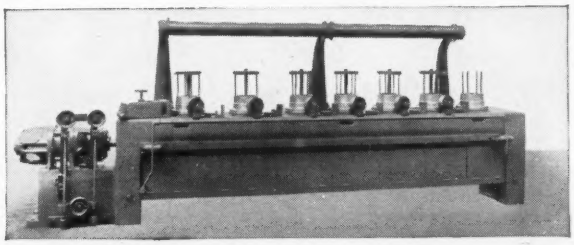
When wire is coiled and cooled on Morgan-Connor Machines it may be drawn at greater speed—with greater profit.

MORGAN CONSTRUCTION CO., Worcester, Mass., U. S. A.
W9

MORGAN
WORCESTER
ENGINEERS AND
MANUFACTURERS



Morgan-Connor Continuous Wire Machine, Type C. Fully equipped with motor and control, clutches and safety stop. Machine takes wire either hard drawn or annealed. Patented wire can be started at about 11 gauge.



Morgan-Connor Continuous Wire Machine, Type D. This machine is designed especially for the drawing of finer sized wire. Starts from No. 17 patented wire.

MORGAN *Wire Machines*

Registry of Used Wire Machinery

We Offer–Subject to Prior Sale–The Following Used Wire Mill Machinery

Waterbury stand spooler for fine wire.

No. 348
Five-block rod bench with gear drive and motor, 26″ and 22″ blocks.

No. 400
Twenty head enameling machine complete, capacity down to .001.

No. 401
Eight head spooler, capacity 200 lb. spools, motor driven.

No. 402
Hayes electric furnaces, automatic control, with 32 head spooler, for fine wire.

No. 403
Waterbury straight roll fine wire machines, motor and belt drive.

No. 432
24 block intermediate frame with 16″ blocks, reducer, and pulley drive.

No. 441
Vertical Olsen tensile testing machines, 10,000

No. 445
Five-head S. & H. florist wire machine.

No. 456
Tinning equipment:
10 and 20 block fine wire units, 8″ block.
8 block unit for 16″ and 22″ blocks.

No. 459
Shuster straightening and cutting machine for ⅝ round.

No. 460
120 National Nail machines, 2D to 60 D.

No. 461
15 Lambert Cut Nail machines 4 D to 10 D.

No. 464
9 Emery Barb Wire Machines, 2 and 4 point.

No. 465
Am. Hard Rubber Acid Pump, Model B-244, 2″ x 4″.

No. 469
Two and four blocks heavy rod benches with motors and drives.

No. 470
24-carrier single deck textile 4″ braiders.

WE HAVE BUYERS FOR THE FOLLOWING

No. 448
7-wire planetary closing machine for 24″ reels.

No. 457
Diamond die polishing machines
1 for .080
2 for .050
3 for .025

No. 458
Equipment for manufacturing Tungsten and Molybdenum wire, press and dies, slug treating, swaging, drawing and spooling machines.

Roll flattener for strips ⅛″ thick up to 20″ wide.
Machine for round edging narrow flats.

No. 472
Turks heads, 3 U, 4 U, 5 U, without rolls.

No. 473
Electro galvanizing machine for screen cloth.

No. 474
Calender rolls for Wire Cloth 8 to 12″ dia. rolls, 36″ length.

No. 475
Bull blocks for ⅝″ steel.

No. 476
Heavy rod bench 3 to 5 blocks all above floor, preferably Morgan.

No. 477
Small Watson Stillman solder extrusion press.

No. 478
Larmuth type stranding machines, 7 and 12 spool, equivalent of N. E. Butt S-25-29-30.

No. 479
Single and double cotton serving machines.

No. 480
24-spindle cotton winding equipment, 4 and 6 inch traverse.

No. 481
3-head strip machines, 6″ and 9″ cutter size.

No. 482
Wax saturating and finishing tanks, small and medium, gas heated drum type.

No. 483
Stringing machines, one for rods up to 3-8, one for No. 4 to No. 12 wire.

No. 484
Shuster machine for ¼″ maximum.

No. 485
Rigid frame stranders, 25 lb. spools, 37 to 137 wires.

No. 486
Planetary closers, 3 or 4 wire, 48″ to 54″ reels.

No. 487
Concentric taping heads, 18″ to 24″ discs.

No. 488
Wardwell braiders, 16 and 24 carrier.

No. 489
60″ and 84″ Rubber mills.

No. 490
Vulcanizers, 72″ x 15 ft. horizontal, 84″ x 8 ft. vertical.

No. 491
Vulcanizer reels 50″ to 60″ diam. x 5 to 8 ft.

No. 492
Wire measuring machines.

No. 493
Scott tensile machines, 12 and 100 lbs.

No. 494
Platform scales, 250, 500, and 1000 lbs.

Dunscomb Associates

BOX 320, C/O WIRE AND WIRE PRODUCTS — 17 EAST 42nd ST., NEW YORK, N. Y.

REGISTRY OF USED WIRE MILL MACHINERY

- **Increased Production**
- **Better Quality Parts**
- **Lower Production Costs**
- **Bigger Profits . . . with**

J & L Cold Heading Wire

because it is:

- **High in Quality**
- **Always Uniform**
- **Accurate to Gauge**
- **Properly Coated**
- **Carefully Inspected**
- **Suitable for both the simplest and most complicated parts.**

Try a test run of J & L Cold Heading Wire and see for yourself, as many other users have, how it can give you greater output, and better quality parts at a lower unit cost.

The J & L Technical staff is available for consultation on any of your more unusual production problems. In many cases, such consultation has resulted in important economies. It may prove equally helpful to you. Your inquiry is invited.

OTHER J&L PRODUCTS FOR MANUFACTURING:
Forging Steel . . . Jalcase Steel . . . Bessemer Screw Steel . . . Shafting . . . Tubing . . . Spring Wire . . . Tin Plate, Black Sheets, and Manufacturing Ternes, Tin Mill Sizes . . . A full line of S.A.E. Carbon Steels.

J&L STEEL

J&L PRODUCTS FOR CONSTRUCTION AND MAINTENANCE:
Structural Shapes, including Junior Beams and Lightweight Channels . . . Concrete Reinforcing Bars . . . Steel Pipe . . . Structural Shapes and Plates . . . Fabricated Structural Work.

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JONES & LAUGHLIN BUILDING, PITTSBURGH, PENNSYLVANIA

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DIAMOND DIES · CARBIDE DIES
UNWIDIE

"Not a better die
but the best"

UNION DIAMOND DIES

A die is known by the companies it serves, and the work it performs.

UNION DIAMOND DIES serve the world's most famous wire drawing companies.

This recognition didn't just happen, it was earned by performance, value received and promises kept.

UNION DIAMOND DIES are the finest tools made for drawing wire.

UNION WIRE DIE CORPORATION

MAIN PLANT AND OFFICES — Stamford, Connecticut

BRANCHES:

Pittsburgh · Chicago · Cleveland · Trenton · Worcester · New York
Hamilton, Ont., Canada · Montrouge, France · Paris, France

WIRE AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip Wire Products and Insulated Wire and Cable

DRAWING—ROLLING—EXTRUDING—FORMING—FABRICATING

Vol. II November 1936 No. II

Designated as

Official Publication By The Wire Association

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For Better Dies For Every Job

Say

VASCOLOY ▲ RAMET

The Tantalum Carbide Die Material • • •

Harder than the hardest of steels, immune to the action of most industrial acids, Vascoloy-Ramet is daily winning a wider acceptance throughout the wire world.

There is a Vascoloy-Ramet Die for every job, and especially for yours.

VANADIUM ALLOYS STEEL COMPANY

Vascoloy-Ramet Division

North Chicago, Illinois

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Submit your manufacturing problems and let our Firthaloy Engineers advise how Firthaloy can give increased production, better manufacturing results and at the same time reduce production costs. — Making dies and wear-resistant parts for every practical application is a specialty with the Firthaloy Department.

Whatever you manufacture, whether wire, rods, tubing, bolts, nuts, screws, rivets, eyelets and ferrules or any similar products there is a Firthaloy die or wear-resistant part to do the job and do it better.

Tell us your manufacturing problems, and let us send a Firthaloy representative to show you how they can be efficiently and economically solved in your plant with Firthaloy.

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Instrument Springs

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Considerations important in the design and manufacture of instrument springs are here discussed, together with the relative merits of extension springs vs. compression springs, the twist of a helical spring under axial load, mechanical hysteresis, creep under load, temperature effect on modulus of elasticity — Elinvar and related nickel-chromium steels, and approved methods of manufacture.

SINCE the discoveries of Robert Hook in the seventeenth century, spring controlled instruments have become increasingly widespread, until today most of the measuring instruments by which time is indicated and weight is ascertained depend for their accuracy upon the performance of a spring. Electrical measuring instruments and pressure meters often employ a spring as their actuating member, so that in the field of engineering, as well as in the everyday life of the individual, instrument springs have assumed an important role.

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SPRINGS used in measuring instruments owe their value to their general conformation to Hook's Law and to their close approach to being perfectly elastic, although in some cases their ability to absorb shock and their low inertia compared with a counterweight are decidedly an asset. Of all phases of spring making, that of instrument spring manufacture is, perhaps, the most delicate and is undertaken generally only by those spring makers who make a specialty of springs of this type. These springs may be spiral, as in the case of electrical instruments, or helical as in the case of spring balances. Flat springs are used in some types of scales commonly known in the trade as "Over and Under" scales and elliptic springs are employed in some force measuring instruments in which the dial is hand calibrated to suit the individual spring. At least ninety-nine percent of springs used in measuring instruments, however, are either spiral or helical, and the helical springs are of the extension type.

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"Hysteresis" and "Creep"

TWO major considerations in the making of instrument springs which are not ordinarily of importance in other types are the effects of "hysteresis" and "creep". If the deflection of a spring under load is measured with sufficient accuracy, it will be found that while all but a small fraction of one percent of the deflection takes place immediately, the deflection will continue to increase for hours and even days.

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REFERRING to Fig. 1. A, two springs are shown connected in series. Between the springs is a dashpot in which a plunger travels in a vertical direction through a highly viscous liquid. If a weight is placed upon the lower spring, it will deflect immediately, while the deflection of the upper spring is retarded by the dashpot, and the deflection of the combination will be as indicated in B. If

sufficient time is allowed for the plunger in the dashpot to travel through the cylinder, the deflection of the upper spring will approach in magnitude that of the lower, and the deflection of the combination will have been greatly increased. The rate of motion of the plunger in the dashpot will be governed by the unbalanced forces acting upon it, which will be the difference in the forces exerted by the upper and lower spring. As time increases the unbalanced force will decrease, and the time deflection diagram of the combination will be as shown in Fig. 2.

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SINCE the rate of motion of the plunger (Fig. 1) is governed by the unbalanced forces acting upon it, its position at any instant is dependent not only upon the time element, but upon the magnitude of the suspended load. If, then, an additional load were originally placed upon the combination, even for a short period of time, and then removed, leaving only the original load suspended from the combination, we might expect the position of the plunger to be somewhat lower than the one it would reach in the same period of time under the weight of the original load only. If, for example, five pounds were suspended from the combination, we would expect the total deflection to be somewhat less than if ten pounds were placed upon the combination and then five of it removed.

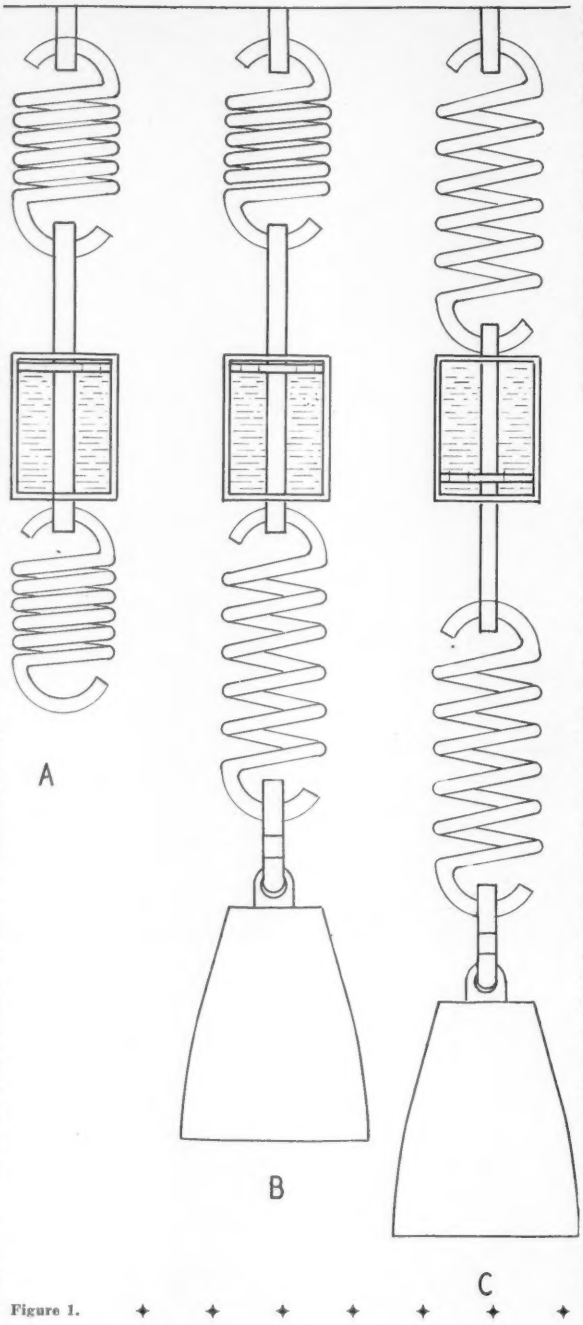

Figure 1.

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A SINGLE spring under load will exhibit on a small scale, characteristics remarkably similar to those of the combination described above. The time-deflection diagram of a spring under load is quite similar to that shown in Fig. 2, the rate of deflection decreasing as time increases and the deflection itself approaching a well defined limit. Fig. 3 shows the hysteresis loop produced by plotting the loading and unloading curves of a spring, from which it will be noted that the maximum hysteresis occurs at about the center or at about one half the maximum load. Tests on scale springs have shown that in putting the spring through its loading and unloading cycle, the hysteresis has been reduced by as much as 75% by permitting the half maximum load to remain on the spring for twenty-four hours, during the loading, then continuing the loading to full capacity and unloading to half capacity without further interruption. The results of such tests as well as others indicate that there is a rather close relationship between creep and hysteresis.

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Springs for Electrical Measuring Instruments

SPRINGS for electrical measuring instruments must meet specifications that are not always required of other types of instrument springs. It is usually desirable that they be of non-magnetic material, that the electric resistance be low and that the temperature coefficient of resistance be as close to zero as a good spring material will permit. In addition, it is important that hysteresis and creep be kept at a minimum. The elastic modulus change in the material brought about by temperature changes is frequently compensated for by temperature effects in other parts of the instrument. In direct current instruments employing permanent magnets, the decrease in the strength of the magnets with increasing temperature offsets the decrease in strength of the springs, so that the net change is not appreciable.

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ANOTHER factor which must be carefully controlled in spiral springs is the tendency to uncoil. Such springs are made by winding and subsequently heat-treating in forming barrels, the subsequent removal from which is accompanied by a degree of uncoiling dependent upon the time and temperature of the heat-treatment. This uncoiling, like the deflection

of a spring under load, may not be completed immediately but may continue even after the instrument is assembled, throwing off the zero reading and calibration of the instrument. By proper heat treatment this tendency can be controlled and kept within very small limits.

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IN order to meet the electrical requirements, springs for electrical measuring instruments are usually made of some alloy of copper, frequently a phosphor-bronze. The material obtains its spring characteristics through cold drawing, and the manner in which the drawing is performed will determine the best subsequent heat treatment. Flat wire is produced by cold rolling the round wire and this is wound into springs which are later heat treated in forming barrels at about 600° F. for approximately twenty to thirty minutes. Tests* have shown that creep and hysteresis can be reduced to a minimum by heating, during the forming operation, at as high a temperature as possible within the softening temperature of the material. This softening temperature will vary not only with the composition of the material but with the amount of cold work to which it has previously been subjected, so that the heat treatment may vary for two spring materials of identical chemical composition and wire size. The tendency to uncoil after assembly in the finished instrument is sometimes overcome by heating the finished spring, after it has been removed from the barrel, for a period of twenty-four hours at 212° F. After whatever uncoiling produced by this process has taken place there is little tendency towards further uncoiling at normal temperatures.

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Scale Springs

FLAT springs are sometimes used in scale construction, either in connection with helical springs in automatically temperature compensating scales, or in scales of the equal arm type, in which case the spring is used to measure but a small fraction of the load, the greater part of the load being counterweighted by loose weights or by a sliding or hanging poise weight on the tare beam, or by both. By far the most common type of scale spring however, is the helical spring of round wire close coiled with no initial tension in the coil.

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WHEN a helical compression spring (Fig. 4) is deflected, its load-deflection characteristic is a curve which is concave upwards due to the fact that the squaring of the ends of such a spring results in a gradual closing of the end coils under load, before contact is made between adjacent coils in the central portion of the spring.

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THIS effect is more marked in the case of short springs with very few coils than in the case of longer springs with many coils, but in the case of the latter the tendency to buckle under a compressive force makes them unsuitable for use in force measuring instruments. The load-deflection diagram of a compression spring with squared and ground ends is shown in Fig. 5.

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A CLOSE coiled extension spring with initial tension between adjacent coils, such as the ordinary extension spring of music wire or other hard drawn wire, or pretempered material, will have a load deflection characteristic which is convex upwards, at least during the initial stages of deflection. This is due to the fact that an initial load without any corresponding deflection is necessary to overcome the initial tension between adjacent coils. Under an increasing load these coils will open one at a time (since the initial tension between any pair of adjacent coils is not absolutely the same) until all coils have opened, after which the load-deflection diagram will be an approximately straight line. (Fig. 6).

AN open coiled extension spring such as that shown in Fig. 7, has a load-deflection diagram that is approximately straight but there are considerations (as will be explained) which render such a spring undesirable where a high degree of accuracy is required.

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THE close coiled helical extension spring with no initial tension between adjacent coils will have a load deflection diagram like that shown in Fig. 8. Such a spring must be carefully designed and properly made within tolerances which are governed by limits of accuracy, set by other parts of the instrument. In order to obtain a clear picture of the degree of accuracy required in the calibration of scale springs it is necessary to review some of the factors that limit the accuracy of the instrument itself, apart from the springs upon which its action depends.

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REFERRING to Fig. 9 it will be noted that twelve points are indicated at which we may find the reason for a scale not being accurate to a microscopic degree. It should be kept in mind in this regard, however, that it is only necessary that such an instrument be kept within the visual accuracy of the observer and within the specifications set forth by the weights and measures departments by the various states and municipalities. It can be truthfully stated that spring balances made by reputable manufacturers have been accurate in operation to a degree well within such prescribed limits, many having retained such accuracy for a period of forty years or longer. Some of the reasons enumerated below are inherent in the scale's construction others may assume important proportions under certain conditions.

1. **The runner into which the spring is fastened may be improperly designed, permitting the spring to lift off under higher capacities, thereby throwing into action an additional half coil and spoiling the calibration of the spring.**
2. **The spring itself may for one of a number of reasons limit the accuracy of the instrument. These reasons are dealt with in detail below.**

* **"Better Instrument Springs" Robert W. Carson, June 26, 1933, meeting Amer. Inst. Electrical Engineers.**

3. The spring hanger or fastening may permit the spring's hook to slip, thus readjusting its position or to turn (due to the tendency of the spring to rotate under load) a given amount, after which further turning is prevented.
4. Excessive friction may occur at the rack fastening or rack fastening may have too much play.
5. Excessive friction may occur at pinion fastening or this fastening may have too much play.
6. Teeth of pinion may not be cut to the necessary degree of accuracy.
7. There may be too much or too little tension between rack and pinion.
8. Teeth of rack may not be cut to desired degree of accuracy.

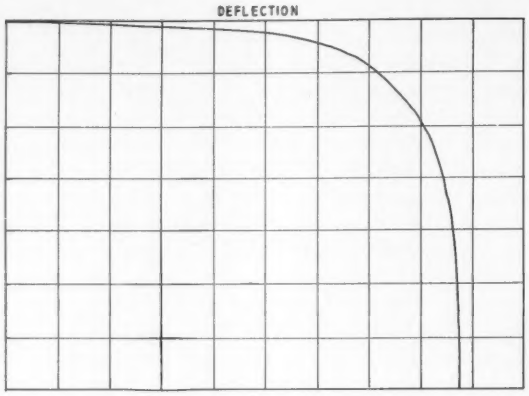

Figure 2.

9. Rack ay not travel in a perfectly plumb line. A slight deviation here may cause as much as 1% error in scale's calibration.
10. Dial of scale may not be accurately calibrated.
11. Pointer of scale may not be accurately balanced.
12. Paper of dial may be so affected by atmospheric conditions as to affect accuracy of calibration. Such atmospheric changes may take place between the printing and mounting of dial or after dial is mounted.

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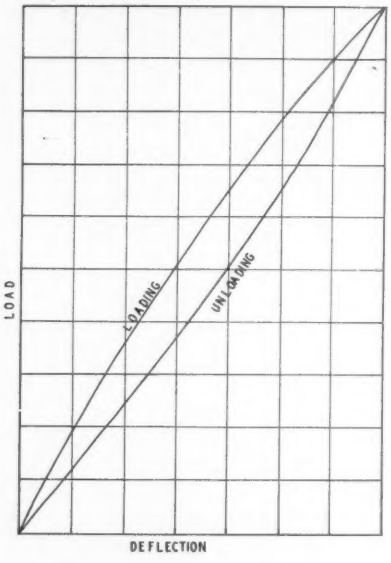
LIKE other measuring instruments, in which cost of production is a factor, it is customary to build spring



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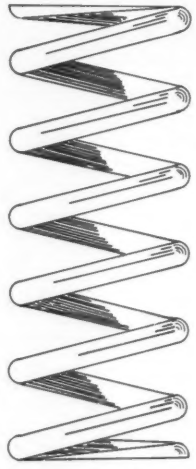

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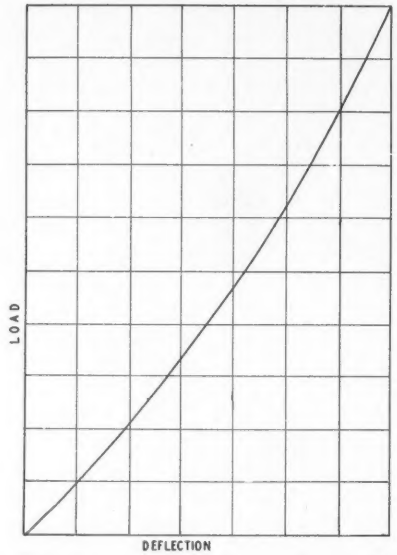

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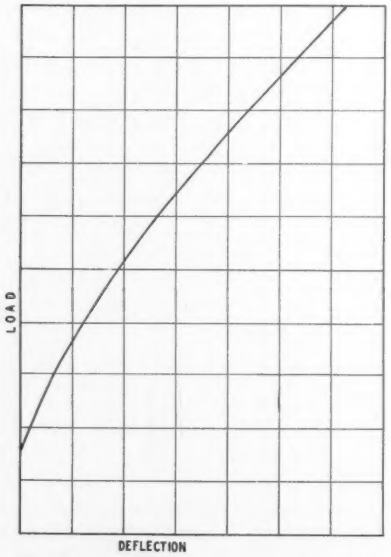

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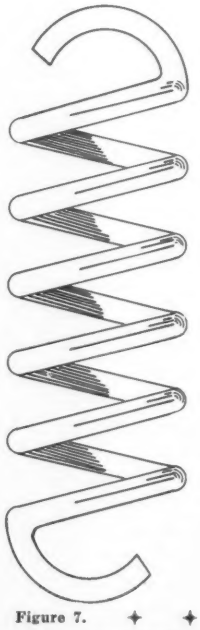

Figure 7.

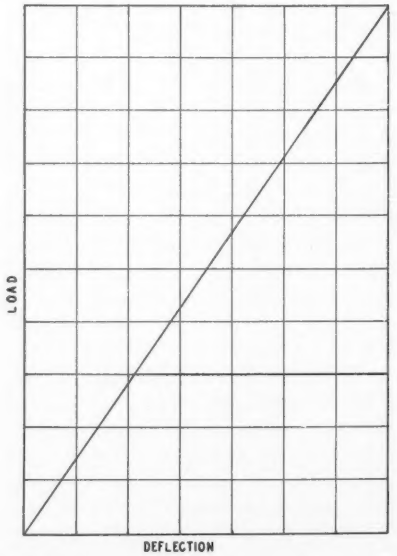

Figure 8.

balances within limits of only useful accuracy, allowing a certain factor of safety within these limits. A spring balance which can be read accurately with the naked eye only to the nearest ounce is constructed as economically as possible to this degree of accuracy. The limits of precision enumerated above are held within such tolerances as the purpose for which the instrument is designed demands. To narrow these tolerances would increase the cost to the purchaser without actually resulting in more accurate readings or increasing in any way the value or usefulness of the instrument.

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THE considerations dealt with in the following discussion of the limits of accuracy of scale springs are in some cases purely academic. Under certain circumstances they may be entirely practical. Since so little has been published upon the subject of this type of spring, a discussion of the academic as well as the practical aspects would seem warranted in a paper dealing with scale springs of the helical type.

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Hysteresis in Scale Springs

AS in the case of springs for electrical measuring instruments, hysteresis in scale springs must be given careful consideration. Since, in actual practice, weighings on spring balances are usually completed in a relatively short space of time (a matter of seconds usually) creep is of little practical importance, except as a means of determining what magnitude of hysteresis may be expected.

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IN practice, hysteresis is measured in the completed spring balance, by what is commonly known as the "back test". This test is made in the scale factory and by sealers employed by the state department of weights and measures after the scale has been sold and put in service. Failure to meet state or municipal requirements, in this respect, results in condemnation of the scale for trade purposes.

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THE "back test" is made by loading the scale to full capac-

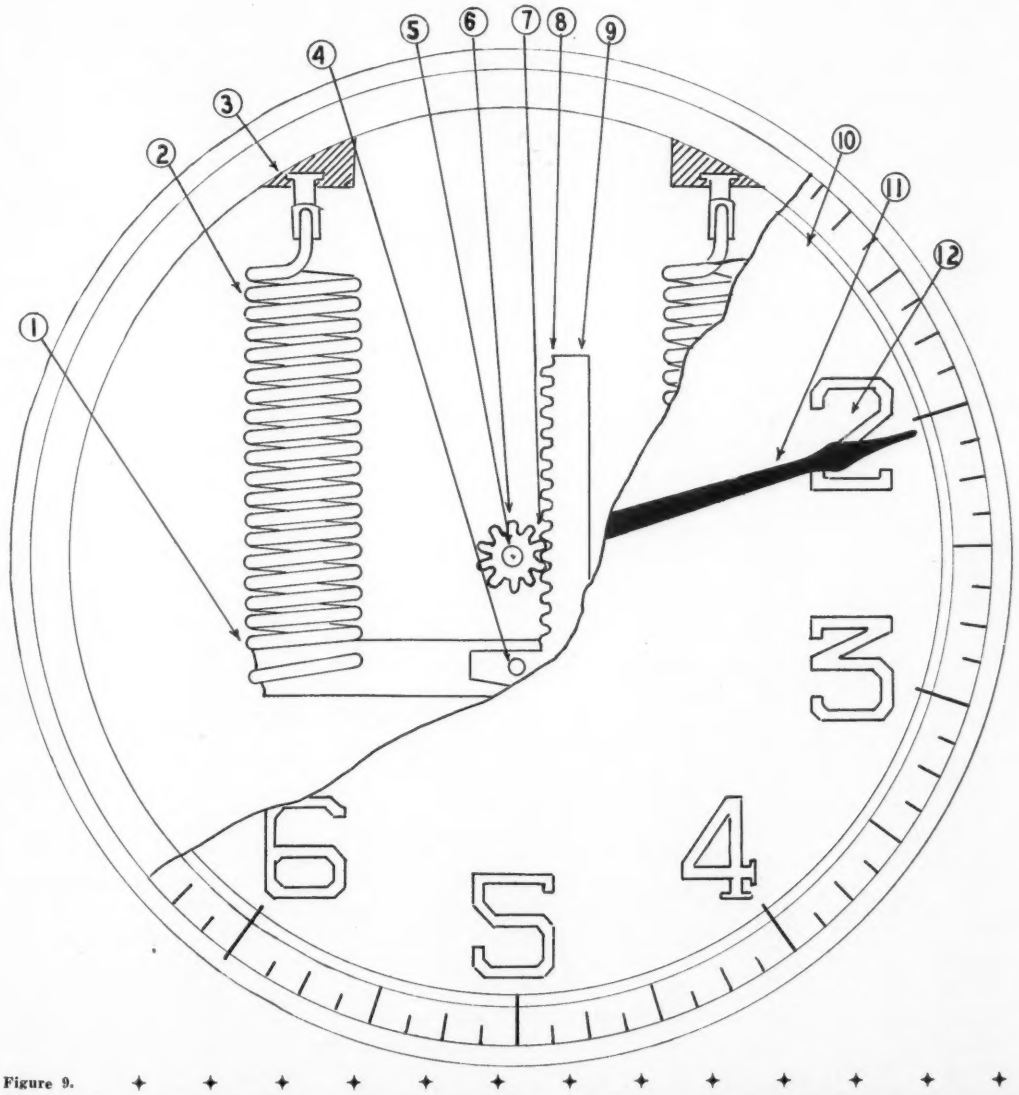

Figure 9.

ity with equal and known increments of loading, and then unloading to no load, by removing these increments of loading one at a time. Inaccuracies, either during the loading or unloading, are noted and measured and if they exceed legal tolerances, the scale is condemned. Excessive hysteresis, if it exists in the springs, is clearly indicated by this test.

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IN a well designed and manufactured scale spring, the hysteresis is kept within one tenth of one percent, and where conditions require, considerably less than this. The magnitude of hysteresis is controlled by the proper selection of material and its subsequent heat treatment and by designing the spring for as low a working stress as conditions will permit.

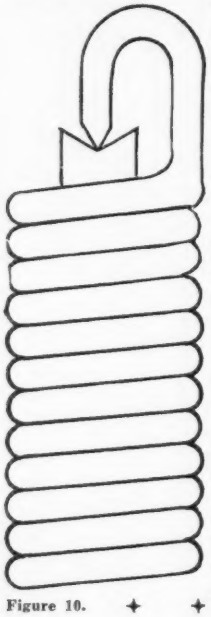

Figure 10.

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Scale springs usually tested for hysteresis by loading to half capacity and measuring the extension under this load, then loading to full capacity, after which half the load is removed and the deflection under half capacity again measured. Since the width of the hysteresis loop is so small (usually in the neighborhood of a few thousandths of an inch) it follows that the deflection measurements must be carefully and accurately made. Usually one of three methods is used,

1. **A screw micrometer with verneier, reading to .0001 in. is used in connection with means for making electrical contact.**
2. **A cathetometer is employed.**
3. **A mirror or prism is used to reflect a light beam.**

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THE measurements must be made, of course, under conditions of minimum vibration and it is also necessary that every precaution be taken to eliminate friction or any shifting of the spring fastenings. Fig. 10 shows one means of spring support used in making hysteresis tests. The end of the wire which forms the spring is ground to a sharp point and looped so as to be brought down above the center of the coil. This point is then supported by an agate in which a conical recess has been formed. A similar attachment may be used at the other end of the spring for supporting the test loads.

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Rotation of Extension Springs

WHEN an extension spring of round wire is extended under load, one end will rotate with respect to the other in the direction of the spring's coiling, so that the net effect will be for the spring to coil further. The amount of rotation may be calculated by the following formula, in which ϕ is the angle of rotation.

P=Load
D=Diameter of Coil
l=Length of wire in spring
α=Angle that coil plane makes with plane normal to axis of helix (See Fig. A.)
d=Diameter of wire
G=Modulus of elasticity in torsion.

$$\phi = \frac{8\ P\ D\ l \sin 2\alpha}{5\pi\ d^4\ G}$$

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IN that class of spring scales, known in the trade as "straight spring balances," the weight of an object is measured by the position of a pointer which moves vertically in a slot and opposite which is a graduated scale. This pointer is attached to a runner which is, in turn fastened to the lower end of a helical extension spring, so that the movement of the pointer under any load is the same as the deflection of the spring. In such scales, the deflection of the spring is, necessarily, great and the angle α correspondingly large, which results in a considerable tendency toward rotation of the lower end of the spring and the pointer which travels in the slot. This rotative tendency may result in a sufficient friction between pointer and sides of the slot to spoil the accuracy of the instrument. In order to overcome this tendency, springs for use in straight spring balances are sometimes wound right hand for half their length and left hand for the remainder. (See Fig. 11). The rotative tendency of one half is then counteracted by that of the other in the opposite direction.

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IN an extension spring of rectangular or elliptic section wire, in which the greater diameter is parallel to the axis of the coil (Fig. 12B.) the rotation will be even greater than in a spring of round wire (Fig. 12A.) However, when such a section is coiled on edge and the ratio of a to b (See Fig. 12C) is approximately 1.3 all tendency to rotate is overcome. If this ratio is increased (See Fig 12D.) the rotation under load will be in the opposite direction to that of a spring of round wire, and the spring will uncoil under loading.

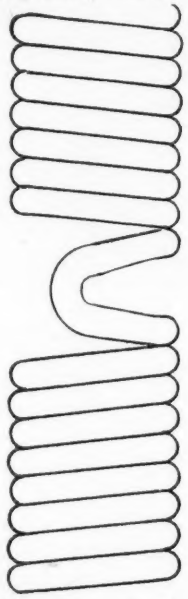

Figure 11.

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IN spite of the fact that the rotating tendency of springs may be overcome by the selection of too many factors favoring the use of round wire to make the use of rectangular wire, coiled on edge, a practical measure in scale spring manufacture. Such a section would, among other things, cause a greater departure from a straight line load-deflection diagram than is obtained with the spring of round wire.

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IN springs for circular balances, the rotating tendency may spoil the spring's calibration, especially if free rotation is permitted during part of the deflection and restrained thereafter. In practice, such springs are designed to permit but little axial deflection, this deflection being multiplied by rack and pinion. The angle α is consequent-

ly kept small and the rotating tendency held at a minimum, if the springs are close coiled with no initial tension.

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Effect of Temperature on Modulus

THE modulus of elasticity of steel wire will vary with temperature changes. The net effect of such temperature changes on scale springs is to increase the deflection of the spring per given load by about one and one-half percent for one hundred degrees Fahrenheit increase in temperature. Where scales are used indoors, this effect may not be important, but under conditions of outdoor use or where scales are moved in and out of refrigerators, this effect of temperature on the torsional modulus of spring material may be of sufficient importance to warrant the use of a compensating device or a special spring material. Most compensating devices depend upon the lengthening and shortening of scale levers or, in the case of simple hanging circular balances, upon the lengthening and shortening of the effective length of an auxiliary spring.

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A NICKEL-CHROMIUM steel known as Elinvar was developed for watch springs some thirty years ago, since which time it has been the subject of many interesting tests and subsequent commercial application. This metal has a modulus of elasticity which is practically constant within a fairly wide range of temperatures. As early as 1923, scale springs were made in this country of this material, but its cost as well as the limited field in which such springs were necessary prevented its wide use. Since that time this metal has been improved upon to overcome some of the objections originally encountered and today it is used in certain types of scales which are exposed to wide degrees of temperature change.

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Load-Deflection Characteristic of Scale Springs

WHILE the load-deflection characteristic of a closely coiled extension spring, without initial tension, may be considered a straight line, this is only true within certain limits, depending upon the spring's design and upon the material of which it is made. The fact that the torsional modulus of the spring material itself will vary slightly under different loads, together with the change in the physical dimensions of the spring as it is extended are responsible for a slight deviation from a straight line when a spring's deflection is plotted against load on the basis of microscopic measurements. M. F. Sayre (New Formulas in Precision Spring Design A. S. M. E. meeting Dec. 3, 1934.) gives the following formula for calculating the deviation from a straight line, in the load-deflection diagram of a helical extension spring with no initial tension.

$$\text{Deviation (in inches)} = -(3 - 2\,GJ/EI)\,\frac{y^2}{4\,L^2}\,\left(H_0 + \frac{y}{2}\right)$$

In which,

G=Modulus of elasticity of material in torsion.

J=Polar moment of inertia of cross section of wire.

E=Modulus of elasticity of material in tension.

I=Moment of inertia of section of wire about its diameter.

y=Maximum deflection of spring.

L=Length of wire in spring.

H_0=Initial length of active portion of spring.

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RESULTS obtained by this formula check very closely with those obtained in actual tests on springs. Fig. 13 shows the approximate deviation from a straight line in the load-deflection diagram of springs coiled of .105 inch round wire on a mean coil diameter of one inch. It will be seen that such a spring of one inch active height may be stretched over one-half inch before the deviation exceeds .0001 in. and one and one half inches before the deviation becomes .001 in. In the construction of circular spring balances, the deflection of the spring may be multiplied twenty times or more by the rack and pinion, so that if it is desired to maintain a reading accurate to within .02 in., it will be necessary to hold

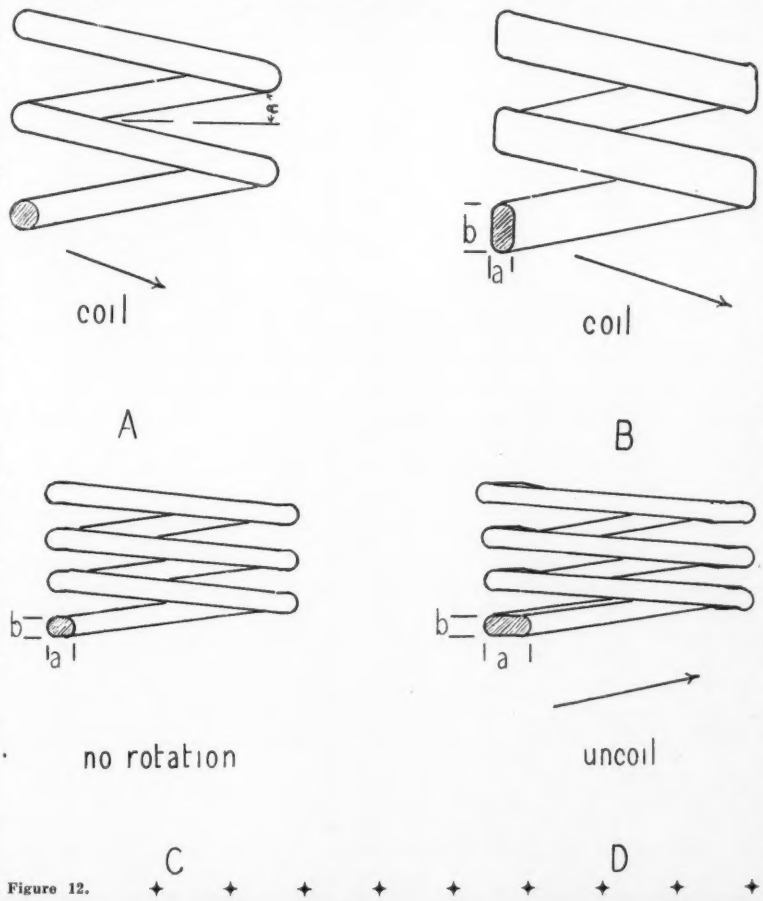

Figure 12.

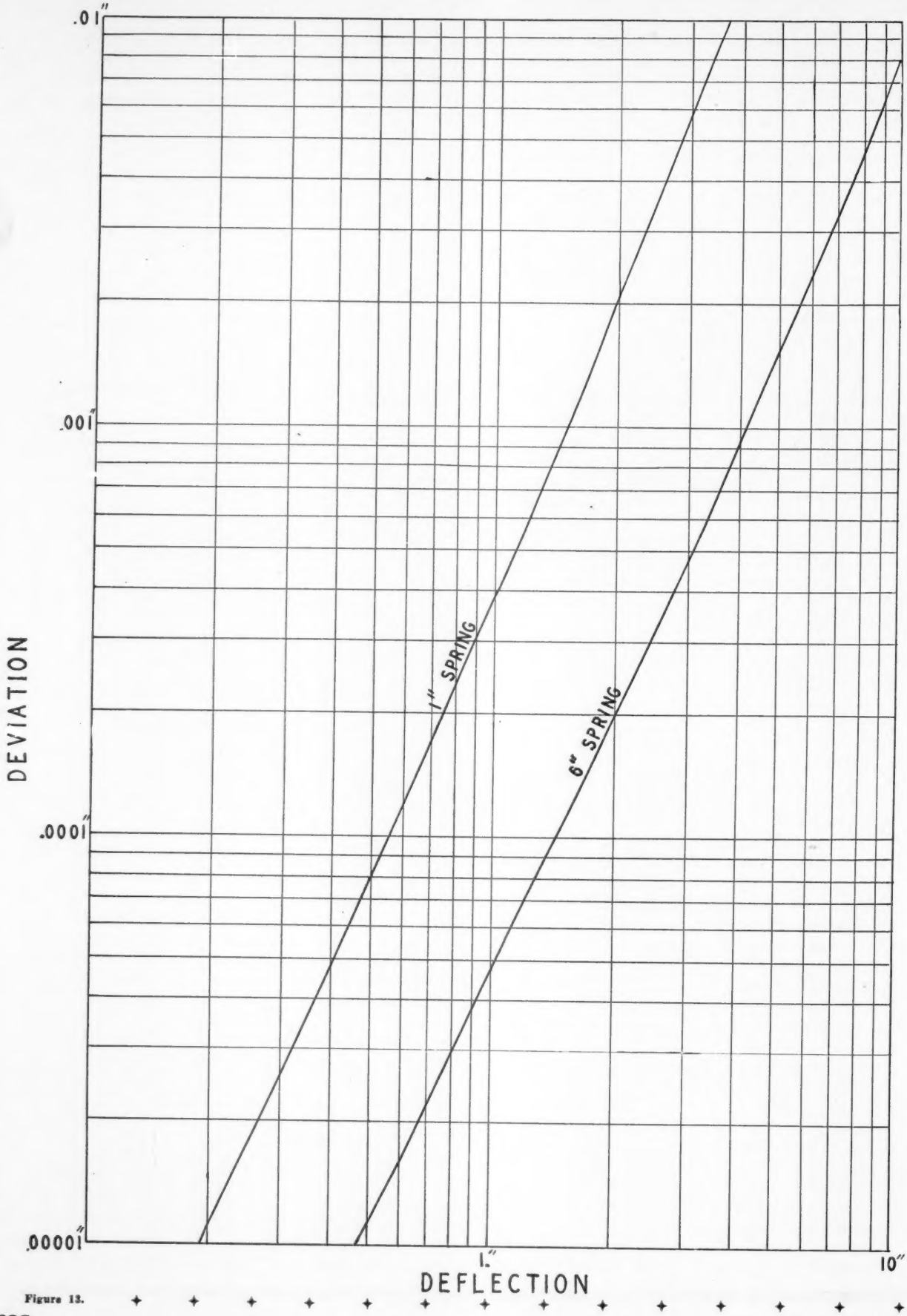
.01"
.001"
.0001"
.00001"
DEVIATION
1" SPRING
6" SPRING
1."
10"
DEFLECTION

Figure 13.

the spring deviation within .001 in. A spring with an active length of 6 in., coiled as indicated above, will permit a deflection of 4 inches before this deviation from a straight line in the spring's calibration is exceeded.

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IT has long been a shop rule (one of those rules of thumb which engineering sometimes proves to have a sound foundation) that a spring for a circular spring balance should be so designed that its deflection will not exceed its useful solid height, and if it can be so designed that its deflection will not exceed half this figure, so much the better. In actual practice an absolutely straight line load-deflection characteristic is not always aimed at, since other factors in the scale's construction may make a slight deviation from the straight line preferable.

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WHERE it has been found impossible to maintain the desired relation between deflection of the spring and the initial height of its active portion, springs of elliptic section wire coiled flat (See Fig. 12B) have sometimes been resorted to in order to control the deviation from a straight line load-deflection characteristic. The use of such section, however, increases the rotating tendency of the spring to such extent that it may have to be coiled part right hand and part left hand to overcome this.

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Manufacture of Scale Springs

FROM the foregoing, it will be seen that scale springs should be of the extension type, that there should be no initial tension between adjacent coils. In addition, if as many coils as possible are contained in a given space, it will bring the load-deflection diagram of the spring closer to a straight line. Also if the spring is coiled close rather than open it will diminish the tendency to rotate under load. By keeping the working stress low, the maximum hysteresis can also be kept low. This sums up to saying that while the spring should have no initial tension between adjacent coils, it should be, nevertheless, closely coiled, and this has an important bearing upon the methods used for manufacturing such springs.

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SCALE springs have been manufactured for well over one hundred years and during that time methods of manufacture have undergone some drastic changes. Today, the methods employed will depend somewhat upon the shop although all scale spring plants have much in common regarding methods of production.

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THE wire used is usually a straight carbon steel which may be a 100% domestic product or may be drawn by an American mill from imported rods. The steel will contain from .85 to 1.00 percent carbon and will be used in a state of dead soft anneal. This wire is coiled either on coiling machines or on a mandrel, after which the springs so formed are cut to length and wired for heat treatment. At one time, it was customary to case harden practically all scale springs but this practice has been almost completely discontinued. The springs are brought to a quenching temperature in a salt bath, or gas furnace of the full muffle type, after which they are quenched and drawn. Sometimes a subsequent treatment is given to reduce hysteresis, in the case of springs for circular spring balances of platform scales. The result is a spring which is closely coiled but in which there exists no initial tension between coils.

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ALLOY steels have been successfully employed in scale spring manufacture, in which case the process of manufacture is identical with that of straight carbon steel springs described above with the exception of the temperatures at which heat treatment is carried on. Music wire has been used in open coiled extension springs, in the case of straight spring balances. In scales of this type any deviation from a straight line load deflection characteristic must be very great before it is discernable, so the objection to this type of spring, as it exists in the case of a circular spring balance, is not applicable.

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WHILE fatigue resisting properties are not of great importance in the case of scale springs, the matter of reducing hysteresis to a minimum is of greatest consequence and calls for great care in the selection of spring material.

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IN addition to a knowledge of springs the manufacturer of scale springs must possess at least a general working knowledge of spring scales, for it is customary for the manufacturer of spring actuated instruments to suspect the spring as the most likely source of trouble when faulty operation of the instrument develops. It frequently happens that in vindicating the spring, the real source of trouble is located and as a matter of record, the well made spring, in spite of the many limits which are placed upon its theoretical accuracy is likely to be the most accurate member of the entire mechanism.

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Bibliography

IN addition to Mr. Carson's paper and that of Mr. Sayre referred to in the text, the following references are of interest in the study of instrument springs.

"Elastic Behavior of Spring Materials" M. F. Sayre, Proceedings of The American Society for Testing Materials, Vol. 30, Part II, 1930.

"Hysteresis Relative to the Operation of Mechanical Springs" J. K. Wood, Mechanical Engineering, Vol. 49, No. 5a.

"The Effect of Temperature upon the Torsional Modulus of Spring Materials" F. P. Zimmerli, W. P. Wood and G. D. Wilson, American Society for Testing Materials, 1930.

"Springs for Electrical Measuring Instruments" B. W. St. Clair, Mechanical Engineering, Vol. 47, No. 11a.

"Characteristics of Weighing Springs" J. W. Rockefeller, Jr., Mechanical Engineering, Vol. 47, No. 11a.

The paper entitled
"Development and Standardization of Types of Military Equipment"
By Captain Frank W. Bullock
Presented Before The
Wire Association Meeting
Will be Published in the
December, 1936 issue of
WIRE AND WIRE PRODUCTS

Wire Association Moves Forward

Convention great success * Scope of Association to be broadened. * * Non-ferrous activities increasing * * * Novest receives 1936 award. + +

AN unusually heavy attendance of mill executives and production men was a feature of the 1936 Wire Association meeting. A list of attendance will be found on page 647. To anyone familiar with the early vicissitudes of the organization period a meeting such as this year's is hard to visualize. However all you have to do is follow the advice of a well-known American, Al Smith, and "look at the record".

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FROM every standpoint, this year's meeting was a great success and the technical papers together with their attendant discussions were more than ordinarily interesting.

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PRECEDING the opening of the technical sessions, there was a joint meeting of the Association Directors, the authors and the program Committee at which the procedure for the meetings to follow was charted. As a result, the program under the leadership of **John C. Callaghan,** Chairman of the Program Committee, functioned smoothly and most efficiently.

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IT is very interesting to note that men came from almost every point in the United States and Canada for this meeting and universally expressed themselves as feeling that they had been more than repaid for the time, effort and money expended.

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THE absence of **John Mordica,** Honorary Past President of the Wire Association, due to his enforced stay in Florida for a rest, was not only greatly felt but largely commented upon. It is well to recall here that Mr. Mordica was our first President, and in the four succeeding years of his continued office in that capacity, helped beyond estimation, the building of this Association, the furthering of its technical effort and the spread of its influence and good will. Mr. Mordica was the recipient of a telegram in the name of the Association, incorporating the regret of all members and guests at his absence and the hope that he would again be with us at our next meeting.

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Association to Broaden Scope to Include Cold Working of Metals

AT the annual meeting of the Wire Association, it was voted to extend the scope of the Association's field and activities to embrace cold working of metals and the finishing and fabrication of all cold worked products including cold heading operations, extrusion operations, drawing operations, etc. This marks a distinct broadening of the activities for the Association and a committee was appointed with **Mr. B. L. McCarthy,** Metallurgist of the Wickwire-Spencer Steel Co., as Chairman to lay plans for the development of this idea along broad and comprehensive lines.

RALPH K. CLIFFORD
General Supt., Continental Steel Corp.
President, The Wire Association

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Non-Ferrous Group Plans for 1937

AS a result of the meetings of our non-ferrous section this year, it has been decided that in 1937 there will be three sessions devoted to non-ferrous topics with specific subjects for each of the sessions as follows:—One session to be devoted to research and metallurgy of non-ferrous metals; a second session to be devoted to processes and methods of production of rod, wire, strip, and extruded shapes and forms. This also includes the production of electric wire and cable; the third session to be devoted to fabricating and finishing operations including insulating, braiding, stranding, covering, etc. It is planned to present this program in continuity from the metallurgy of the wire rod or bar through the finished product for the customer.

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Plant Inspections

MANY interesting and instructive plant inspections were made available this year to our members and guests, among them being that of the **Cleveland Tramrail Division** of the Cleveland Crane and Engineering Co., where a straight line cleaning house was set up in operation; the **American Steel and Wire Co.,** Newburg Works, where our visitors were very courteously shown all details of the plant and its operations; the **Lamson & Sessions Co.** for cold heading practice and equipment;

the **Corrigan-McKinney** plant of the Republic Steel Corp. where visitors were enabled to inspect a completely integrated modern steel plant; the **General Electric Institute** at Nela Park; and a demonstration of a new process for tempering and patenting without the use of furnaces at the plant of the **Cleveland Wire Spring Co.**

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Wire Association Award to Notvest

THE Wire Association award for the "most meritorious contribution to the literature on the wire industry during the year 1936" was presented to **Robert Notvest,** Chief Engineer, Welding Division, J. D. Adams Co., Indianapolis, Ind., for his paper, "Steel for Arc Welding Electrodes".

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THE paper was a discussion of the vital metallurgical characteristics of drawn wire to be used for arc welding electrodes, and the author gave evidence to show that the requirements for wire for this purpose are entirely different from all other wire requirements due to the superheating of the metal and its quick freezing when utilized as arc welding electrodes. The paper presents a new theory on a controversial subject and should lead to further research which will ultimately benefit the entire industry.

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McCarthy Receives Certificate of Honorable Mention

A CERTIFICATE of Honorable Mention was presented to **B. L. McCarthy,** Metallurgist, Wickwire Spencer Steel Co., Buffalo, N. Y., for his paper, "Plastic Deformation in Wire Drawing". Mr. McCarthy was the recipient of the Wire Association Award for 1935 and this year's paper was an elaboration and continuation of the work covered in his 1935 research paper.

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High Lights of the Meetings

IN the absence of Mr. J. W. Rockefeller, Jr., author of the paper, "The Selection of Spring Wire Materials", **Mr. E. J. P. Fisher,** Metallurgist of Republic Steel Corp., Chicago, presented a digest of this paper accompanied by his own comments which proved particularly interesting. Mr. Fisher will be remembered as the winner of the 1934 Wire Association Medal Award with a paper which related to the production of spring wire and he was, therefore, unusually well equipped to present Mr. Rockefeller's paper this year.

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MR. E. E. Clark, Mechanical Engineer, Wire and Cable Section, General Electric Co., Schenectady, N. Y., presented and discussed the paper, "Power for Cascade Drawing of Copper", in the absence of Paul M. Mueller, the author. Mr. Clark was eminently qualified for this presentation and his analysis of the paper resulted in a very interesting discussion.

✦ ✦ Wire Association Booth. ✦ ✦

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THE address by **Captain Frank W. Bullock,** United States Army, who is procurement and contract officer for the Signal Corps at the Army Base in Brooklyn, N. Y., resulted in a very interesting discussion and many questions were asked and answered relating to methods of preparing specifications and placing of contracts for needed supplies. Captain Bullock had on exhibition a number of samples of various types of finished wires and cables used by the military and naval services and these were inspected with great interest. Following Captain Bullock's talk, there was a sound motion picture showing the wire communications system as used within an infantry regiment and demonstrating in use some types of telephone equipment and wire required for military work. Later in the week a second picture was shown illustrating the same points for the anti-aircraft artillery regiment. These pictures were very much out of the ordinary, very instructive, and resulted in requests from many members that if possible we show pictures of a similar nature at our next meeting.

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The Technical Discussions

ATTENDANCE at the technical sessions was excellent as is shown by registration figures of 198 for this year's meetings against 160 last year. For the fifth successive year, the "open discussion" type of meeting was conducted. Some comment was heard to the effect that the discussion lagged slightly behind last year's standard in interest. If this is true, it may have been due in some measure to a partial return to our former practice of having the papers read by the author, rather than summarized. A summary always seems to bring out more controversial aspects of the subject than a formal paper, and it sets a tone of informality which encourages debate from the floor. It also leaves more time for such debate. The directors have already approved a suggestion that an author be invited to send in, with his paper, names of ten or more members who have particular interest in the subject or special knowledge of it and that they be furnished with galley proofs and be invited to participate in the discussion. The meetings of the Wire Association have long been known as the liveliest and most productive among the technical societies and we must take care not to lose that reputation, whether by crowding papers, treating subjects which lend themselves more readily to exposition than to argument, or otherwise permitting an air of formality to creep into the sessions.

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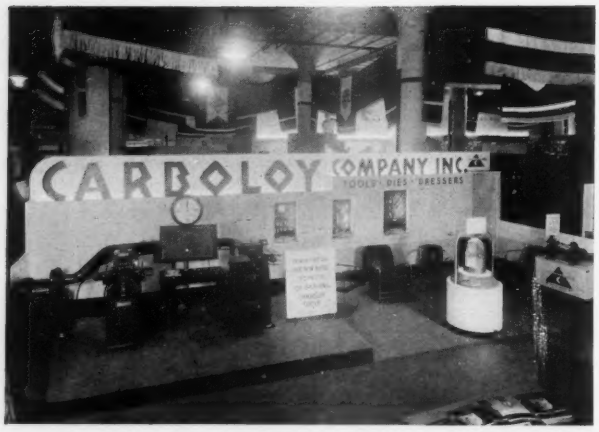
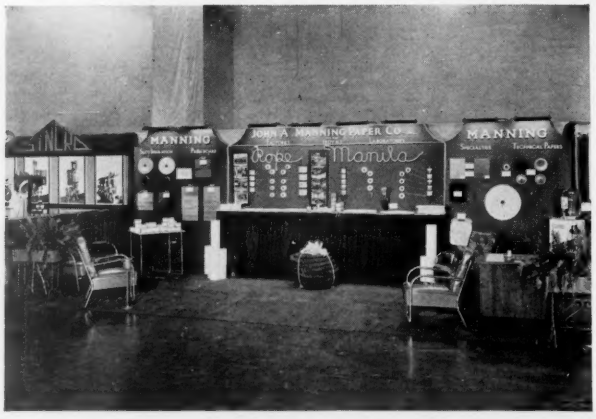
ON Tuesday morning, **Mr. John C. Callaghan,** chairman of the program committee introduced



Carboloy Company, Inc.

Exhibits: Rapid Grinding Technique for Grinding Cemented Carbide Dies and Tools, 6″ and 10″ Tool Grinders, Standard and Special Tools.



Manning Paper Co., Inc.

Exhibits: Slot Papers, Press-boards, Rope Manila Insulating Papers, Corkamoid Papers, Corkamoid Radio Cones, Rubber Latex Saturated Papers.

Syncro Machine Co.

Exhibits: Syncro Gearless Flyer Serving Machine and Samples of Covered Wire.

Norton Company.

Exhibits: Grinding Wheels, Variety of Abrasives, Mounted Points, Norbide Products and Norton Refractories.

Republic Steel Corp.

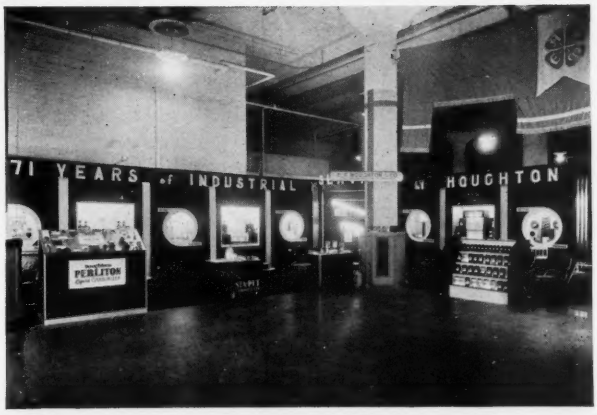
Exhibits: Applications of Agathon Alloy Steels, Enduro Stainless and Heat Resisting Steel, Toncan Iron Enameling Stock and Galvanized Sheets, Upson Bolts and Nuts, Pig Iron, etc.

Electric Furnace Co.

Exhibits: Photographs of Controlled Atmosphere Furnaces for Various Heat Treating Processes, Elfurno Generators, Grid Type Heating Element and Samples of Material Treated in These Furnaces.

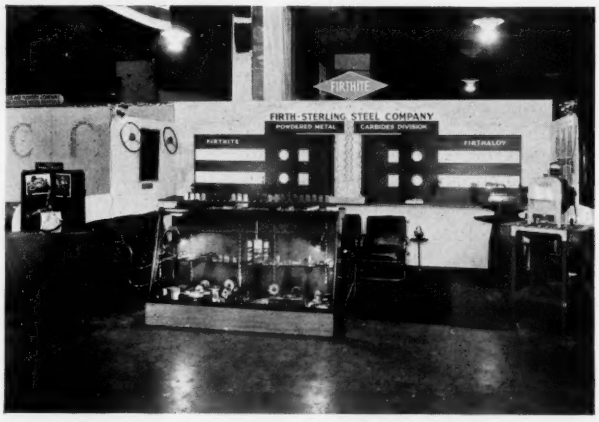
American Machine & Foundry Co.

Exhibits: Lead Alloy Coating Known as Amaloy, Samples of Amaloy Coated Copper, Steel, Nickel Chrome, Alloy and Resistance Wires and Rubber Covered Copper Electrical Conductors.



E. F. Houghton & Co.

Exhibits: Improvements in Pickling Inhibitors, New Wire Drawing Compounds, Metal Cleaners, Perliton Liquid Carburizer, Sta-Put Lubricants, Leather Beltings and Packings.

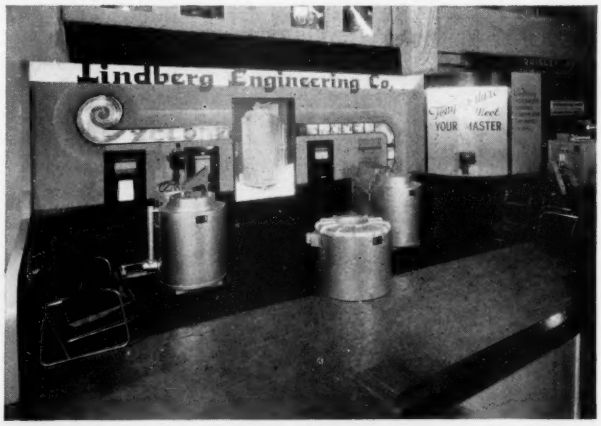


Firth Sterling Steel Co.

Exhibits: Firthaloy Wire Drawing Dies, Tube Drawing Dies, Firth Braze-Rite Furnace, Firthite Sintered Carbide Tools, and Sterling Stainless Steel Products.

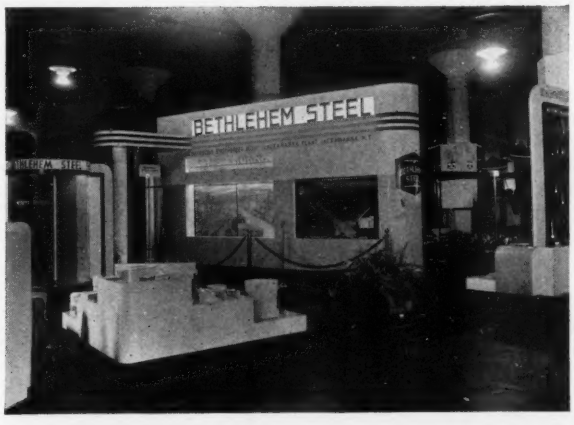
General Electric Co.

Exhibits: Controlled-Atmosphere Mesh-Belt Brazing Furnace, Portable Motor Generator Welders, Welding Transformers, and Electrodes.



Lindberg Engineering Co.

Exhibits: Cyclone Gas and Electric Furnaces, Lindberg Throttling Valve, Screw Type Pot Furnace for Lead, Cyanide, etc.



Bethlehem Steel Co.

Exhibits: Finished Products of Various Applications of Bethanized Wire and Talking Pictures of the Making of Alloy Steel and of Wire.

President **Ralph K. Clifford.** In opening the technical sessions, Mr. Clifford said:

"Gentlemen, it is indeed a pleasure, on behalf of your officers and directors, to welcome you to the sixth annual meeting of the Wire Association. The number already present and the advance indications as to the attendance for our technical sessions point toward another highly successful meeting. That the work of our group is rapidly becoming more important, there can be no doubt. With a steady increase in interest and membership throughout the depression years, an experience not common to all the technical organizations, the past year has shown an even more rapid rate of increase, with more than sixty new members.

No group, such as ours, can be truly successful unless there are sufficiently important reasons for its existence. Your officers and directors cannot make a successful organization. The growing success of our society can be largely attributed to the fact that we have, as a fundamental reason for existence, "the advancement of learning". Coupled with this are the vitally necessary factors of good will, and cooperation between the individual members.

I need not remind you, gentlemen, that more reliable information relative to the drawing and processing of wire, has been recorded, and more research work carried on, during the few years covering the younger days of the Wire Association, than in all the years of the prior history of the industry. There is no question but that our organization has been a very important factor in bringing this about.

With all due respect to our programme committee and to the authors of the highly commendable papers to be presented in these meetings, let me remind you that a great deal of what you take away from these meetings with you will come from the open discussions. We hope that you will enter into these discussions freely, and not wait to be called upon.

Allow me again to remind you of the importance of becoming acquainted with your fellow workers in the wire industry. Our meetings afford an opportunity, in this respect, which should not be overlooked.

Allow me to pay my respects to our Honorary President, Jack Mordica, whose untiring efforts have meant so much to the Association through its formative period. He has guided us to firm ground and I hope that when the present year has ended, we shall have added honorably to his untarnished record. If such is the case, a major share of the credit is due the work horse of the organization, Mr. Brown.

It is my feeling, gentlemen, that we are firmly established as a successful and growing organization. As such, we should avail ourselves of the vigor and vitality so prevalent among our membership and elect a different president each year. This will be my recommendation to your board of directors.

We will now again turn the meeting over to our program chairman, who, with his committee, has functioned so well to make these meetings successful."

MR. John C. Callaghan, as Chairman of the Program Committee, introduced **Mr. Frederick A. Westphal,** Chairman of the first session, in a brief address, after which the Convention swung into its regular method of functioning.

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MR. A. F. Anjeskey presented his paper on wire pickling, a very clear exposition of the benefits which have followed, and apparently have been associated with, the "straight-line" cleaning layout.

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THE discussion was brisk, and revolved to some extent about the responsibility of straight line layout for improved cleaning practice. The consensus seemed to be that while the tie-up was perhaps not as close as it appeared, the straight-line layout, by tying in better with schemes of material handling, had proved a distinctly valuable forward step in mill practice.

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MR. H. M. Heyn's paper on "Atmospheres and Furnaces" was well received. While the discussion did not develop any interesting differences of opinion, it seemed to bring out a general feeling that atmospheres were still decidedly delicate and more than a little experimental.

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MR. R. B. Whyte presided over the afternoon session. Illness having prevented **Mr. J. W. Rockefeller's** attendance, his paper was presented by **E. J. P. Fisher,** who alternately summarized and read, and whose participation in the discussion served, as always, to clarify the points debated.

JOHN C. CALLAGHAN
Works Manager, Canada Works, Steel Co., of Canada. Chairman, Program Committee.

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MR. Robert Notvest's presentation of what later proved to be the prize winning paper, "Steel for Arc Welding Electrodes" was a very pleasant surprise. The paper was highly technical, representing, as it did, an enormous amount of research in a highly specialized subject. In spite of its great interest to a minority of those present, its presentation could easily have been soporific in the highest degree. Mr. Notvest, however, touched only the high spots and touched them in a way that seared them into his hearers' minds as though they were in truth electric arcs. Bursts of laughter from the audience soon brought in all the lounge lizards from the ante-room, and the session proved one of the liveliest and pleasantest of the year.

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MR. R. S. Simmons contributed observations on analyses and steel practices conducive to the production of good welding steel and Mr. Notvest made it abundantly clear that he feels that further improvement in arc welding is right up to the steel metallurgist.

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ON Wednesday morning, under the chairmanship of **Ray Simmons, Mr. C. W. Meyers** discussed "Research as Applied to Manufacturing," and **Captain Frank W. Bullock** presented his paper on "Development and Standardization of Types of Military Equipment," which was followed by a motion picture on signal communications within the infantry regiment.

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THE afternoon session, presided over by **Mr. Louis Winkler,** was devoted to a summary by **Mr. B. L. McCarthy** of his paper on "Plastic Deformation in Wire Drawing," and the ensuing discussion. As usual, when Mr. McCarthy is available, the discussion ran fairly far afield, but was probably as productive of solid thinking as any paper of the year. And, as

✦ ✦ Surface Combustion Corp. ✦ ✦

Exhibits: SC Gas Fired Radiant Heating Element in Action With Pyrex Windows for Inspection Purposes, SC High Speed Furnace, SC Air Heater, and Samples of Products Heat Treated Wth SC Equipment. ✦ ✦

✦ ✦ Driver-Harris Company. ✦ ✦

Exhibits: Heat and Corrosion Resisting Alloys Such as "Nichrome", Cimet, etc., in Form of Castings, Bars, Strip, Lead Pots, Diamond Dies, Carburizing Containers, Sheet Containers, Enameling Racks, and Dipping Baskets.

usual, the session was continued in small units through the ante-rooms and corridors. Twenty-four hours later, members were still engaged in rotary arguments over the correct definition of the word "normalize." Wherever this man McCarthy passes, arguments boil in his wake.

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THURSDAY morning's session, in charge of **Mr. Waldo Sherman,** was well attended by the nonferrous group, in fact better attended than any session yet devoted to the red metals. **Mr. J. N. Kenyon's** paper on "Tough Pitch and Oxygen-Free Copper" was freely discussed, and a second paper on "Vacuum Lead Sheath" by **Mr. R. W. Atkinson,** aroused much interest. **Mr. Paul Mueller** was unable to attend, and his paper on "Power Requirements" was not discussed.

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THE afternoon session, under the chairmanship of **Mr. Kenneth B. Lewis,** was devoted to carbide dies. **Mr. A. R. Zapp's** paper was of a general nature, dealing with the primary processes in the preparation of metallic carbides and their incorporation in various matrices or die service. **Mr. K. R. Beardslee** discussed actual die-room practice as it related to preparing and servicing dies and attending to the paper work and distribution of dies.

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THE only differences of opinion brought out in the discussions related to the systems of accounting for dies in service. It appears that practically no individual runs of die life are now regularly kept by wire manufacturers. The simple brass-check system is much in vogue for keeping track of dies in service with various modifications to care for shift changes. Where paper records of any consequences are kept, it is because they can be kept without increasing the personnel. Losses of dies seem to be amazingly low, one large mill reporting the loss of a single die on the brass check system in a year.

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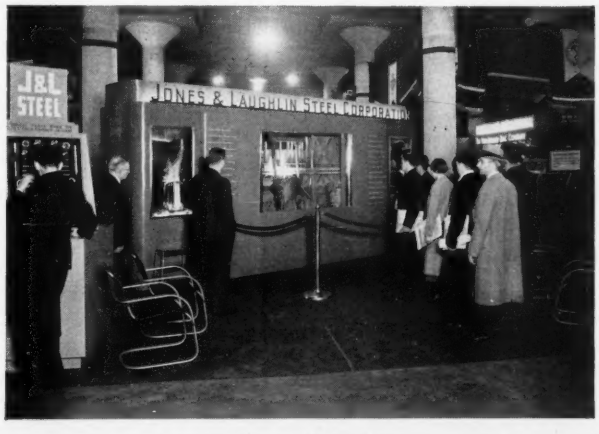
National Metals Exposition

THE show this year was by far the best ever put on by our

✦ ✦ Elevator Supplies Co. ✦ ✦

Exhibits: High Speed Fine Wire Drawing Machine, Complete With Spooling Attachment, Built for High Speed Wire Producton. Equipped With 16 Dies, Producing No. 42 B & S Gauge Wire at Rate of 5000 F. P. M. Finished Wire Sizes From No. 34 to 44 B & S Gauge. ✦ ✦ ✦



✦ ✦ Jones & Laughlin Steel Corp. ✦ ✦

Exhibits: Tilting Open Hearth Furnace, Steel Products and Parts, Including Special Cold Drawn Shapes, Wide Cold Rolled Flats, and Bessemer Screw Stock, and Spring Wire Testing Machine Testing a Spring Unit Made of J & L Spring Wire. ✦ ✦ ✦ ✦ ✦ ✦

good friend **"Bill" Eisenman** of the American Society for Metals and a tribute should be paid at this point to his energy and ingenuity in making this such a great success, not only for the exhibitors but for those of the various other cooperating societies. Many expressions from visitors were heard who stated individually and collectively that they were pleased with the courteous and efficient manner with which they were handled by the various officials and employees of the Exposition. Part of the success and smooth working of the entire Exposition may be credited to the fact that this was the first time that the ruling of "controlled attendance" had been practiced and this in itself led to such favorable results for the exhibitors and those attending that it is hoped it will be the rule from now on.

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Exhibits of Interest to the Wire Industry

AMONG the exhibits of more than usual interest to the wire men, attending were the following: **Acme Steel Co.**, Chicago, Ill., showing colored cold rolled strip steel; **Allegheny Steel Co.**, Brackenridge, Pa., exhibiting fabricated items of Allegheny metal such as strip, tubing, wire, rivets, etc.; **American Car & Foundry Co.**, New York, N. Y., exhibiting a six foot bar heater for any diameter of stock from ½ to 1"; **American Gas Association**, New York, N. Y., which as a joint exhibit of their associated companies showed various types of gas fired furnaces and apparatus in operation; the Amaloy Division of the **American Machine & Foundry Co.**, New York, N. Y., which had an operating exhibit showing how the Amaloy coating was applied to copper and steel wire; the **American Steel & Wire Co.**, Cleveland, O., being part of the exhibit of the U. S. Steel Corp. (This exhibit had the unusual feature of a talking Robot which attracted a great deal of attention) **Armstrong Cork Products Co.**, Lancaster, Pa., operating a small gas fired furnace to demonstrate the efficiency of their insulating bricks and also exhibiting samples of various insulating brick; **Bethlehem Steel Co.**, Bethlehem, Pa., exhibiting finished products of various applications of Bethanized wire together with a 45 minute talking picture showing the complete process of manufacture of "Bethanized Wire"; the **Carboloy Company**, Detroit, Michigan, demonstrating the new six and ten inch tool grinders and outlining the latest grinding technique for grinding cemented carbide dies and tools; **Driver-Harris Co.** exhibiting heat and corrosion resisting alloys such as "Nichrome", Chromax, Cimet; in the form of castings, bars, strip, lead pots, diamond dies, etc.; **Electric Furnace Co.**, Salem, Ohio, exhibiting new developments in controlled atmosphere furnaces for brazing, scale free heat treating, and bright annealing ferrous and non-ferrous metals, including wire, sheet, tubing and strip; **Elevator Supplies Co., Inc.**, Hoboken, N. J., showing a high-speed fine wire drawing machine, complete with spooling attachment in operation. This machine is designed to produce finished wire in sizes ranging from No. 34 to No. 44, B & S gauge and will produce No. 42 B & S gauge wire at the rate of 5000 F. P. M.; **Firth-Sterling Steel Co.**, McKeesport, Pa., exhibiting many types of wire drawing dies, tube drawing dies, etc. together with a new Firth Braze-Rite Furnace, brazing Firthite, sintered carbide tips onto tool shanks; **General Electric Co.**, Schenectady, N. Y., exhibiting in operation a thirty foot atmosphere controlled mesh belt brazing furnace, also a variety of different types of Electric welders, etc.; the **Harnischfeger Corp.**, Milwaukee, Wis., exhibiting in operation a new Automatic Welding Head which is the first to use standard coated rods enabling welding to be put on a mass production basis with the uniform, high speed results possible only with coated electrodes, also exhibiting a lift hoist of 250 lbs. capacity, and a one ton electric hoist with variable speed control; **E. F. Houghton & Co.** exhibiting STA-PUT lubricants, metal cleaners for cleaning after carburizing, pickling inhibitors, industrial lubricants, leather belting and packings; **International Nickel Co., Inc.**, New York, N. Y., exhibiting alloys of nickel both ferrous and non ferrous; **Jones & Laughlin Steel Corp.**, Pittsburgh, Pa., exhibiting in open operation a large scale working model of a tilting open hearth furnace which by a unique arrangement of lights and liquid represented, effective realism, the operation of tapping a heat of steel. Supplementing this central display was an interesting and comprehensive display of steel products, and parts, including special cold drawn shapes, wide cold rolled flats, and Bessemer Screw stock. Another feature of particular interest to wiremen was a specially designed and constructed fatigue testing machine in operation testing a spring unit made of J & L spring wire. An interesting assortment of parts made of J & L cold heading wire was also shown. **Lindberg Engineering Co.**, Chicago, Ill., exhibiting in operation gas and electric Cyclone furnaces, including a screw type pot furnace for lead, cyanide, etc.; **John A. Manning Paper Co., Inc.**, Troy, N. Y., exhibiting rope papers and methods

R. NOTVEST

Engineer, Welding Division, J. D. Adams Company, Indianapolis, Indiana. Awarded the Wire Association Medal for the most meritorious paper on wire manufacture or fabrication during the year.

of applying same to copper wires as insulation, together with numerous specialty papers for motor slot insulation, transformer insulation, radio speaker insulation, etc.; **Manhattan Rubber Mfg. Co.,** Passaic, N. J., exhibiting in operation abrasive cut off wheels and finishing wheels of a new type for stainless steel; **Mullite Refractories Co.,** Shelton, Conn., exhibiting a display of refractory shapes as manufactured by Mullite and showing a 500 pound steel melting furnace with a Mullite Refractory roof; **Norton Company,** Worcester, Mass., exhibiting in operation general purpose grinding wheels, tool grinding wheels, mounted points, Norbide products, and Norton Refractories; **Page Steel and Wire Co.,** Division of American Chain Co., Inc., Monessen, Pa., exhibiting stainless steel fence and tennis nets, together with all types of electrodes and gas welding rods; **Production Machine Co.,** Greenfield, Mass., exhibiting in operation a centerless belt feed polishing, finishing and buffing machine for tube rod and bar work; **Republic Steel Corp.,** Cleveland, Ohio, exhibiting interesting applications of their various alloy, stainless, and heat resisting steels, Toncan Iron, enamelling stock and galvanized sheets, Upson Bolts and Nuts, and various types of wire and wire products. A most interesting feature of this exhibit was the electrically controlled animated map showing clearly and visually the locations of the various mines, mills, warehouses, and sales offices of the company; **John A. Roebling Sons Co.,** Trenton, N. J., exhibiting wire rope and miscellaneous round and flat wire; **Rustless Iron and Steel Corp.,** Baltimore, Md., exhibiting rustless or stainless billets, bars, rods and wire in various commercial forms and finished articles and machine parts fabricated from rustless or stainless bars, rods and wire; **Surface Combustion Co.,** Toledo, Ohio, exhibiting high speed furnaces, air heaters and gas fired radiant tubes which had glass inserted in them so that the interior operation was visible; **Syncro Machine Co.,** Newark, N. J., exhibiting in operation the Syncro gearless flyer serving machine for serving magnet wires, bare, stranded conductors and S. J. cords, etc., with cellulose ribbons and paper and fibrous materials; **U. S. Steel Corp. Subsidiaries,** Pittsburgh, Pa. This was a rounded out display of progress in steel making, combining light, color and motion, dramatizing the development of steel; **Vanadium Alloys Steel Co.,** Latrobe, Pa., exhibiting tantalum carbide tipped tools, drawing dies, sizing dies, and the products fabricated by them; **Wilson Mechanical Instrument Co.,** New York, N. Y., exhibiting the "Rockwell" hardness tester in operation together with work support accessories, spares and renewals; **Youngstown Sheet and Tube Co.,** Youngstown, Ohio. A replica of 125 ton open hearth steel ladle was shown in operation. A most unusual feature was that the ladle had an access to the interior containing illuminated picture showing open hearth processes. Yoloy, Youngstown's high tension, corrosion resisting steel together with various other commodities including wire and wire products were also exhibited.

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IT is more than evident in looking through this comprehensive list of exhibits designed to educate and interest producers of wire and manufacturers and fabricators of products made either wholly or in part of wire, rod, cold drawn bar and strip that the wire industry is becoming more and more of a factor each year not only as an important component part of the basic metal industries, but also as a great influence on the economic development of the country as a whole. Each year brings new developments in materials, processes and machines of production; each year further brings new demands for better metallurgical research and more exact work on the part of the wire mill and manufacturer of finished products. With wire entering so largely into every day life, over 150,000 items now being listed and with more uses developing every day, it becomes evident that our industry is only now entering into its own. From the standpoint of mill practice the production process starts—not in the mill—but in the requirements of the customer. That is the governing factor and all production centers around this fact. An exposition such as the National Metals Congress aids all production executives and keeps them informed on metallurgical progress and machine developments. Let us look forward and work together toward a larger, better and more comprehensive Convention and Exhibit for 1937.

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Wire Association Attendance List—1936 Meeting

AKIN, W. M., Asst. to Pres.,
Laclede Steel Company,
St. Louis, Missouri.

ANDERSON, G. H., President,
Graham Nail & Wire Products, Ltd.,
Toronto, Ontario, Canada.

ANJESKEY, A. F., Sales Manager,
Cleveland Tramrail Division,
Cleveland Crane & Engineering Company,
Wickliffe, Ohio.

BARNINGHAM, CHARLES S., Sales Mgr.,
New England Butt Company,
Providence, R. I.

BARTHLEMESS, JOSEPH F., Prod. Mgr.,
National Lock Washer Co.,
Milwaukee, Wisconsin.

BASSETT, WM. H., JR., Mgr. Met. Div. 1,
Anaconda Wire & Cable Company
Scarsdale, New York.

BEAMAN, P. A.,
Morgan Construction Co.,
Worcester, Mass.

BEARDSLEE, K. R., Gen. Sales Mgr.,
Carboloy Company, Inc.,
Detroit, Michigan.

BILLERBECK, WM. J., C. E.
American Insulating Machinery Co.,
Philadelphia, Pa.

BOGMAN, MAJOR JAMES H. BEALS,
Signal Corps, U. S. Army,
Chicago, Illinois.

BOLL, JOHN K., Sales Mgr.,
Wheeling Steel Corp.,
Wheeling, West Virginia.

BRALEY, S. A., Fellow,
Mellon Institute,
Pittsburgh, Pa.

BREINING, JOHN J., Supt. Wire Mill,
Pittsburgh Steel Company,
Monessen, Pa.

BROADDUS, E. T.,
Firth-Sterling Steel Co.,
Kansas City, Missouri.

BRODEN, G. A., President,
Broden Construction Company,
Cleveland, Ohio.

BRONSON, WALTER D., Chicago Repr.,
Union Wire Die Corp.,
Chicago, Illinois.

BROWN, RICHARD E., Publisher,
WIRE & WIRE PRODUCTS,
New York, N. Y.

BUCHANAN, D. D., Asst. Gen. Mgr.,
Union Drawn Steel Company,
Massillon, Ohio.

BULLOCK, FRANK W., Captain,
Signal Corps, U. S. Army,
Brooklyn, New York.

BUYNACK, A. J., Asst. Wire Mill Supt.,
The National Screw & Mfg. Co.,
Cleveland, Ohio.

CALLAGHAN, JOHN C., Works Mgr.,
Canada Works,
Steel Company of Canada, Ltd.,
Hamilton, Ontario, Canada.

CARL, A. F., Sales,
Cleveland Tramrail Division,
Cleveland Crane & Eng. Co.,
Wickliffe, Ohio.

CARNAHAN, H. B., Asst. Wks. Mgr.,
Canada Wire & Cable Co., Ltd.,
Toronto, Ontario, Canada.

CARY, S. P., Asst. Supt.,
Buffalo Bolt Company,
N. Tonawanda, New York.

CLARK, ARTHUR P., Sales,
Union Wire Die Corp.,
New York, N. Y.

(Please turn to Page 664)

The Preparation and Microscopic Examination of Metallic Specimens

PART III

By G. W. Pirk,
Metallurgist, General Research Laboratories,
General Cable Corp., Rome N. Y.

A study of the microscopic examination of metals published in three parts. Part I—Method of selecting sample, cutting, mounting and polishing specimen, was published in August. Part II—Etching, both steel and copper, was published in September. Part III—herewith outlines the results obtained from the microscopic and macroscopic examination of metals.

IN the previous discussions which appeared in the August and September issues of WIRE AND WIRE PRODUCTS, a complete description was given of the method of selecting the sample, and the cutting, mounting, and polishing of the specimen in Part I, and of etching for both steel and copper in Part II. The summary of the results obtained is given herewith.

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Results Otained From the Microscopic and Macroscopic Examination of Metals

AFTER the structure has been developed the work of polishing and etching has been in vain if the observations are incorrectly interpreted.

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Macro-Examination

THE macro-examination furnishes valuable information regarding seams, surface cracks, internal cracks, pipes, segregations, dendritic patterns, uniformity of grain size, purity and porosity distribution, etc. The above points will be briefly discussed and although many of them are directed mainly toward the study of ferrous material they apply in a general way to the non-ferrous metals and alloys also.

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Seams

SEAMS in rolled material are of varying depth and generally extend in the direction of rolling. In forged stock the seams generally arrange themselves in the direction of the plastic flow. In steel seams are detrimental since they may open into actual cracks during the hardening operation if the metal is heat treated. In rolled rod seams in the surfaces are generally referred to as "fins" and result from overfilling of the grooves in the rolls, twisting or "turning over" in one of the rectangular passes. In this case the correction is made by adjusting the rolls. In some cases the detrimental effect of seams can be eliminated if sufficient surface is machined off to remove them and is expensive.

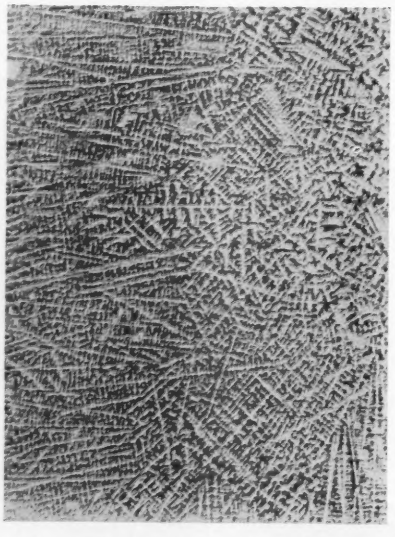

Fig. 3. Dendritic Pattern on Surface of Etched Cast Steel Ingot. The Columnar Dendrites at the Left Were Next to the Mold Surface and Indicate the Direction of Heat Flow During Solidification.

Surface Cracks

SURFACE cracks as revealed after deep etching generally follows an irregular path and may result from improper processing during heating, rolling or forging. On steel surfaces cracks may result from a number of conditions of which improper heat treating or defective grinding procedure are the most frequent. Some of the sources of trouble from the first cause are too bright a heat, forcing the heat and improper drawing or tempering. Under the second cause are grouped such factors as too hard a grinding wheel, too deep a cut, inadequate supply of coolant, or improper application of the coolant. Undissipated or excessive local heating may be sufficient to cause enough unequal expansion of the ground surface to cause surface checking. Surface checks may be caused by the macro-etch itself if the steel has not been properly drawn after tempering.

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Internal Cracks

INTERNAL cracks in steel shapes can be easily seen after macro-etching or may be revealed by a fracture test. Bright, shiny areas on a fractured surface indicate flakes.

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Pipes

PIPES are internal cavities which are associated with segregated impurities which are deeply attacked by the etching reagent.

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Segregation

WHEN segregation occurs it is revealed by the severity of the attack. If the segregation is se-

vere and is in the center of the ingot it may appear like a pipe. Sometimes the segregation is grouped in rectangular form around the center. Pits after macro-etching are generally indicative of non-metallic inclusions.

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IF the macro-etch indicates segregation it is generally advisable to make a microscopic check on the affected areas before rejecting the stock. The microscopic examination will decide whether

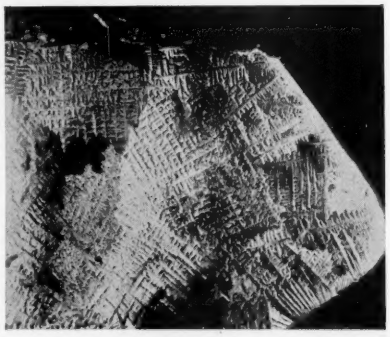

Fig. 4. Dendrites on the Surface of Cast Bismuth.

the segregation is metallic segregation, a peculiar crystal form or arrangement, or a concentration of impurities.

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Dendritic Patterns

DENDRITIC forms can be detected in steel that has had extensive mechanical working as well as in cast metal. Dendritic segregation alone is insufficient cause to reject material unless it can be related directly to service failures or to segregated non-metallics such as sulphides, etc. which are incapable of diffusing or being dispersed.

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FIGS. 3 and 4 illustrate dendrites in cast steel, and on the surface of cast bismuth.

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Grain Size

THE following photos illustrate variations in grain size on the cross section of two common brands of electrolytic wire bars. The differences in grain size indicate that entirely different conditions prevailed during the period of casting and solidification. If these sections are examined at a low magnification (75X) or below, dendrites will also be found and differences in porosity will be noted not only between the two sections but also within the same section.

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Microscopic Examination

THE microscope is not only a research instrument but may be utilized to obtain information which has great practical value. In the following paragraphs there will be given condensed case histories and illustrative examples of problems which were successfully studied by means of the microscope. There will also be shown characteristic structures of some common engineering materials.

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Case No. I

SEVERAL lots of 90% copper, 10% tin bronze rod were being drawn in a wire mill. One lot drew satisfactorily, while the other gave trouble due to excessive breaks. Dies and dips were studied and found to be in good order. Physical tests showed a variation in tensile strength and elongation. A microscopic examination was then made and revealed a striking structural difference between the two lots.

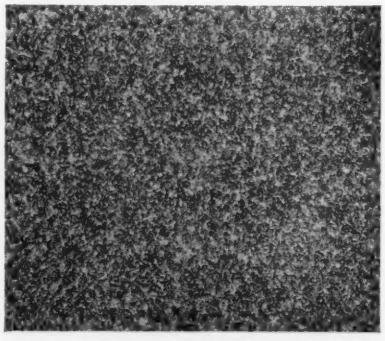

Fig. 5. Grain Size of Bronze Rod That Gave Difficulty on Drawing Into Wire. X100. ✦

Fig. 6. Grain Size of Bronze Rod That Drew Into Wire Without Difficulty. X100. ✦

THE lot which drew well had a larger grain size than the lot which gave trouble. Also, the lot which gave trouble during wire drawing had cracks in the surface. Since the cracks were in the rolled rod the rolling process was suspected. A check up of the rolling mill was made, the condition located and remedied. A subsequent examination showed that the cracks had been eliminated. The difference in grain size indicated that the finishing temperature was different. A chemical analysis shed little light on the problem since the analyses were practically identical. The cause was therefore not readily apparent, but was easily detected with the microscope. Raising the finishing temperature increased the grain size and the material drew without difficulty.

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THIS is a good illustration of how the microscope was used to locate the cause of a condition which was seriously hampering production and ordinarily might have taken much valuable time before being eliminated. Figs. 5 and 6 illustrate the grain sizes of the two materials.

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Case II

DURING the forming operations used in making brass radiator shells, the production department reported that a certain percentage of the sheets failed due to cracking. Although the loss was not particularly high at any one time, yet the rejections over a period of time

Fig. 7. Alpha Brass Radiator Sheet That Cracked During Processing. Note Grain Size Irregularity. X75. ✦ ✦ ✦

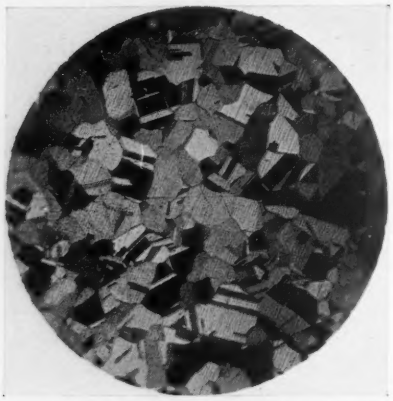

Fig. 8. Grain Size of Alpha Brass Sheet That Performed Satisfactorily. Note Size and Uniformity of Grains. X75.

were of such magnitude that the scrap charged against the department were sufficient to detract from its efficiency. A check of the routine analyses and tests was made and showed no variation that one might not suspect in a commercial sheet.

A microscopic examination was then made of the sheets that performed satisfactorily and of those that cracked. Invariably the sheets that cracked showed grain size contrast, whereas the sheets that showed satisfactory performance had a uniform grain size. Figs. 7 and 8 illustrate the structures observed.

THE difficulty was traced to nonuniformity in the annealing practice and when this was corrected the grain size was found to become uniform and the trouble disappeared. The case points out the need for structural uniformity in brass products intended for deep drawing, or else the metal will not flow or deform uniformly.

Case III

DURING the heading operation in the manufacture of large copper rivets the factory reported that a considerable number of the finished rivets showed deep tears in the head. A notation was sent with the samples submitted to the laboratory that the trouble might possibly be attributed to "grain size".

UPON visually examining the samples it was noted that in every case the deep tears were only on one side of the rivet. This immediately suggested that the trouble might be connected in some way with the set of the bar, since the set is composed mainly of the copper — copper oxide eutectic which is relatively brittle compared to the remainder of the bar which is much lower in oxide. Sections for microscopic examination were taken as shown in sketch D.

Sketch D.

THE head was cut off along the line A-A and the bottom of the head polished. Another section was cut along B-B and polished.

Fig. 9. Shows Tear in Rivet Head and the Surrounding Structure. The Black Specks are Copper Oxide Particles Strung Out in the Direction of Metal Flow. Unetched X100.

FIG. 9 shows the tear and the surrounding structure. The original assumption is borne out and another fact is brought to light, namely, that scale has been pushed into the surface during the hot rolling operation.

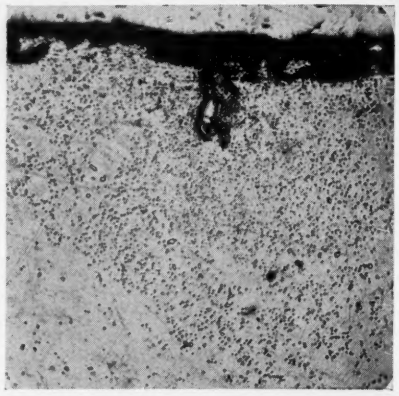

Fig. 10. Shows Structure in Shank of Rivet. The Small Particles are Oxide and are from the "Set" of the Bar. Note the Particle of Scale Penetrating into the Surface. Unetched X100.

THE black "specks" are the copper oxide of the eutectic (set of the bar), which has been broken up by the previous hot rolling operation. Note also that the copper oxide has aligned itself in the direction of flow in the rivet head. In the bottom of the V shaped tear will be noted the particle of rolled-in scale. In Fig. 10 is shown the structure at B-B as observed along the same side as that on which the tear is located. The set is again visible as is a particle of rolled-in scale in the surface of the rod. The trouble in this case was due to several causes: first, the set was relatively heavy and being less ductile than the remainder, was very susceptible to the presence of rolled-in scale particles which acted as notches and caused concentration of the stress in these areas which resulted in tearing.

CONDITIONS such as this do not occur continually but the particular case illustrates the type of condition that may arise and cause trouble. Just to complete the story the grain size was found to be normal.

THIS illustrates the type of information that may be obtained from examining the polished and unetched surface. Copper oxide has a distinctive bluish color and therefore its size and distribution can be readily studied and the quantity present can also be clearly observed. The entire problem was solved by examining the polished and unetched surface.

Case IV

A reciprocating steel machine part failed causing damage which was extensive and involved considerable loss of money. In order to determine whether the failure was due to defective material or to faulty design several sections were taken both near the fracture and at some distance away.

Fig. 11. Shows Slag Inclusions, Cracks and Non-Uniformity of Micro-Structure Near Fracture of Failed Machine Part. Etched Saturated Solution of Picric Acid in Alcohol. X200.

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FIG. 11 illustrates the structures found near the fracture. Examination of the photo-micrograph reveals several points which point to the conclusion that could be attributed with reasonable certainty to defective material. First, there are non-metallic foreign inclusions, which appear as elongated greyish streaks and are possibly manganese sulfide. Second, there has been segregation as is revealed by the structural non-uniformity. The mechanism of the failure was probably something on the following order. The inclusions acted as notches and caused concentration of stress in these areas resulting in the formation of a fatigue crack. Several cracks may be seen in the right of Fig. 11. During operation the cracks gradually increased in magnitude reducing the effective cross-section and thus increasing the stress on the remaining sound metal. When the cracks became sufficiently extensive so that the sound metal could no longer bear the load, it snapped suddenly, resulting in the failure. Add to this the accompanying structural non-uniformity and the cause of failure becomes evident.

Typical Structures

IN the following section there will be illustrated some typical structures found in metals and alloys.

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FIG. 12 shows the polygonal structure found in very pure carbon-free iron. This structure is characteristic of pure cast metals.

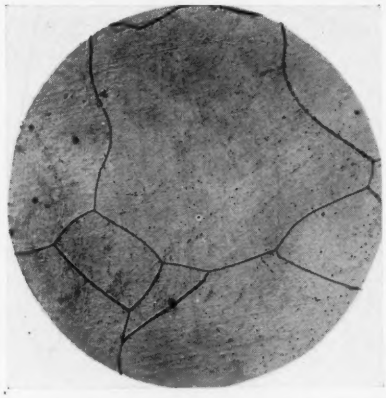

Fig. 12. Polygonal Grains in Cast High Purity Iron. Picric Acid Etch X100.

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FIG. 13 is a sample of the same iron after being slightly compressed in a vise. The surface was etched before straining. The irregular wavy appearance on the surface of some of the grains is due to slip planes. It will be noted that slip does not take place with equal facility in each and every grain, but depends upon the crystal orientation. It also brings out the fact that even slight straining, as in a vise, can materially effect the microstructure and should therefore be avoided when cutting and preparing specimens.

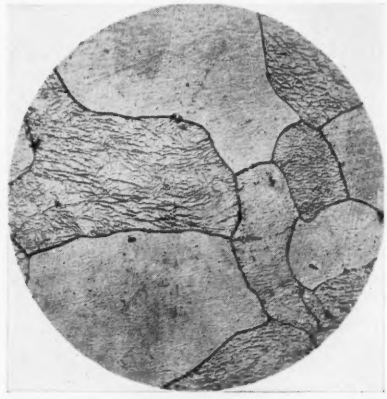

Fig. 13. Same Iron as in Fig. 12. After Slight Straining by Compression. The "Wavy" Appearance on Some of the Grains are Slip Planes. Picric Acid Etch. X100.

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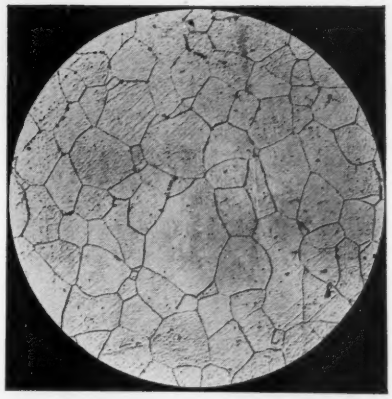

Fig. 14. Polygonal Grains on Cross Section of Wrought Iron Rod. Picric Acid Etch X100.

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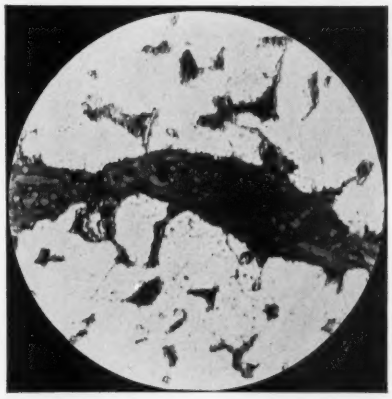

Fig. 15. Slag Inclusion on Longitudinal Section of Same Wrought Iron Rod. Note the Duplex Structure. X500.

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FIGS. 14 and 15 illustrate some typical structures found in wrought iron; Fig. 14 shows the polygonal grain structure as seen on the cross section of a ⅝" rolled rod. The black specks are foreign inclusions.

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FIG. 15 shows a slag inclusion found on a longitudinal section of the same rod. Note the duplex structure of the slag inclusion. The background of the slag streak is manganese sulphide and the lighter or dispersed constituent is probably manganese silicate. The smaller areas are unresolved pearlite since this particular sample contained some carbon.

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THERE are two general groups of cast iron, namely, gray iron and white iron. Structurally the essential difference between the two is that in gray iron the carbon is partly in the uncombined form and is present as graphite flakes

and as carbide in Pearlite, while in white iron the carbon is mostly combined to form iron carbide, and Pearlite.

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THE presence of cementite or combined carbon makes white iron relatively hard and brittle. Chilled iron is white cast iron which has been cast against a "chill" to bring about rapid cooling and thus produce white iron. Such an iron when cast in a sand mold where cooling is slower will be gray iron.

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GRAY iron obtains its name from its characteristic gray fracture and contains no massive or free cementite. In gray iron the structures found are free ferrite (iron), free carbon in the form of graphite and pearlite—a mixture of iron and iron carbide. The ground mass in gray iron may be principally ferrite, broken up by millions of graphite flakes and some pearlitic areas, or entirely pearlite and graphite. When there is considerable pearlite plus ferrite, the fracture is mottled and consequently the iron is known as mottled iron.

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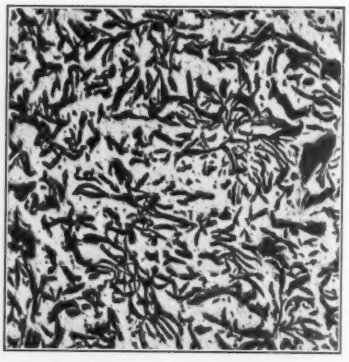

Fig. 16. Structure of Unalloyed Gray Iron.

FIG. 16 shows the structure of an unalloyed gray iron. The black constituent is graphite. It is always advisable to examine cast iron in the unetchable condition as this will give reliable information concerning the size and distribution of the graphite flakes.

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FIG. 17 at a higher magnification shows the several constituents found in a grey cast iron.

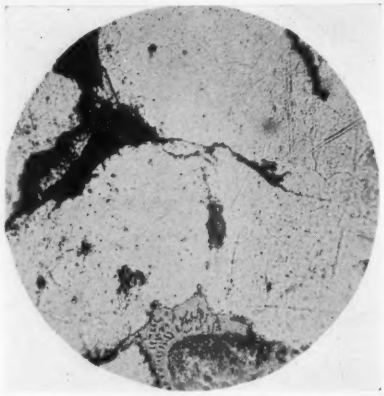

Fig. 17. Typical Structures Found Gray Cast Iron. X500. ✦ ✦ ✦ ✦

THE black areas are graphite and the white structureless ground mass is ferrite (plain iron). In the lower portion are shown the phosphide eutectic (Steadite) and immediately adjoining it is some pearlite, which because of its fineness appears diffuse and is therefore not completely resolved at this magnification. The phosphide generally occurs in this characteristic herring-bone structure.

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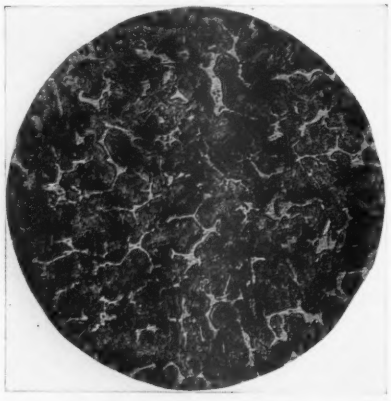

Fig. 18. Structure of White Cast Iron. The Black Areas are Pearlite and the White Areas Cementite. X100. ✦ ✦ ✦ ✦

FIGS. 18 to 20 illustrate some typical structures found in white cast iron. The white constituent of Fig. 18 is cementite (iron carbide—Fe_3C) and the black areas pearlite. Figs. 19 and 20 show the pearlitic areas and the massive cementite at higher magnifications.

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FIGS. 21 and 22 illustrate the structures found in the surface of a chilled iron roll; the white areas of Fig. 21 are carbide (cementite) and the gray areas pearlite. Fig. 22 shows the same area at a higher magnification.

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Fig. 19. Same Areas as Shown in Fig. 18. Shows Lamellar Pearlite and Massive Cementite Plates. X900. ✦ ✦ ✦ ✦ ✦

Fig. 20. White Case Iron. The Lamellar Constituent is Pearlite. The Massive Plates are Iron Carbide (Cementite). X600. ✦ ✦

Fig. 21. Structure of Chilled Iron Roll. X100.

Fig. 22. Same Sample as Fig. 21 Only at a Higher Magnification. X200. ✦ ✦ ✦

FIG. 23 is interesting because of several reasons. First it illustrates the effect of machining on the microstructure. The curved areas at the top of Fig. 23 are the grains of cold rolled steel which have been distorted by machining on a milling machine. Various sizes of these steel sections were placed vertically in a mold and cast iron poured in, the purpose being to find a section which would support the core placed in the mold and yet fuse with the cast iron poured into the mold so as to form a steam tight joint.

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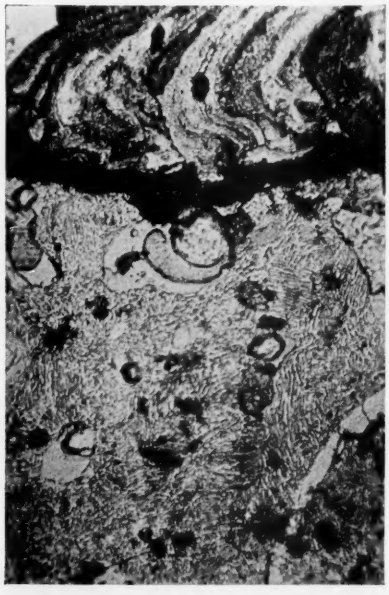

Fig. 23. Shows Distorted Grains Due to Machining-Top. Oxide Seams (Black Horizontal Line) Below Distorted Grains and Chilled Iron Structure-Bottom. X250. ✦ ✦ ✦

THIS is really another example of how the microscope aided in solving a rather troublesome problem.

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THE steel section was sufficiently large so that it did not fuse to the iron poured in but acted as chill producing the white iron structure at the left. The black areas in the left hand portion of Fig. 23 are small graphite flakes. The black horizontal line dividing the photo into two portions is oxide. When the size of the cold rolled section was reduced it fused with the cast iron poured into the mold and formed a tight joint.

✦ ✦ ✦

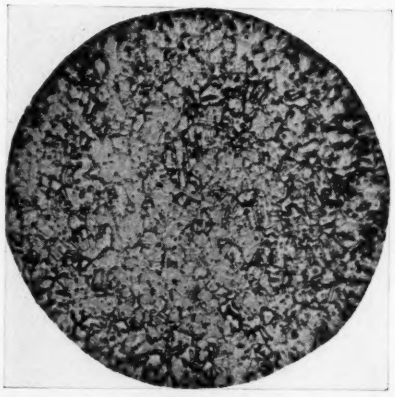

Fig. 24. Cross Section of No. 22 B & S Gauge Electrolytic Copper Wire, Heated 30 Min. in Hydrogen at 850°C. Note Fissures and Pits. ✦

Fig. 25. Cross Section of No. 11 B & S Gauge Oxygen Free Copper Wire Heated 30 Min. in Hydrogen at 850°C. Note Absence of Pits and Fissures. ✦ ✦ ✦ ✦

FIGS. 24 and 25 illustrate the effect of hydrogen annealing on ordinary tough pitch electrolytic copper and on oxygen-free copper.

✦ ✦ ✦

IN this instance the microscope again gives unmistakable evidence of the effect of reducing gases in embrittling copper. The structure of Fig. 24 is honeycombed with pits and fissures which break up the continuity of the copper and make it brittle. The hydrogen has reacted with the copper oxide, reducing it to copper and forming water, which at the annealing temperature is steam and literally tears the metal apart because of the extreme pressure developed.

✦ ✦ ✦

THE pits of Fig. 24 are the places where the oxide formerly was and the fissures are grain boundaries which have been separated by the steam formed.

✦ ✦ ✦

IN the absence of copper oxide this reaction can not take place and the metal retains its continuity and remains ductile. The grain size contrast developed is characteristic of high annealing temperatures, in this case 1562 deg. F. (850 deg. C.).

✦ ✦ ✦

Fig. 26. Cross Section 60-40 Brass Twice Extruded and Then Forged. X500. ✦ ✦

FIG. 27 illustrates a typical structure found in 60-40 (alpha/beta) brass twice extruded and then forged. The various hot working procedures have effectively broken up the casting structure.

✦ ✦ ✦

FIG. 27 illustrates a typical structure found in 88-10-2 bronze. The black areas are gas holes and are evidence of porosity. During subsequent hot rolling these become welded together unless the

Fig. 27. Structure of 88-10-2 Cast Bronze, Showing Dendrites and Gas Holes. X75. ✦ ✦

sides of the holes are coated with a film, such as oxide, which prevents welding.

✦ ✦ ✦

Conclusion

IN the foregoing paragraphs the generally used methods for polishing and etching samples for microscopic examination have been given. It is well to again emphasize that every step and each detail of every step must be carefully executed. Even the utmost care in subsequent operations will not remove an error introduced in one of the preceeding steps. If an error has occurred it must be corrected before proceeding any further. The value of the entire microscopic examination depends on a carefully prepared specimen free from structural alterations introduced by careless polishing. If after polishing and etching the surface is rough and shows pits and scratches some step in the polishing technique has been neglected and the only way to correct it is to go back and repeat the entire procedure, paying strict attention to details.

✦ ✦ ✦

IT is also well to remember that the examination of a large number of specimens does not necessarily give the greatest and most reliable amount of information, but a few carefully prepared specimens will give information which in reliability greatly exceeds that from a greater number of carelessly prepared.

✦ ✦ ✦

IN conclusion the writer wishes to acknowledge the interest and support of Mr. R. A. Schatzel, Research Director, during the preparation of the paper and his permission to publish the same.

✦ ✦ ✦

TABLE II

Reference No.	Now is	
60	(5)	C. H. Desch "Metallography", Longmans, Green & Co., New York (1913).
61	(6)	O. F. Hudson "Etching Reagents and Their Application", Jr. Inst. Metals (British) Vol. 13, 193, (1915).
53	(7)	J. R. Villella "Delving Into Metal Structures", The Iron Age, Vol. 117, p. 261, 834, 903 (1926).
55	(8)	Jerome Strauss "Etching Aluminum Bronze", Chem. Met. Eng. Vol. 28, No. 19, p. 852 (1923).
52	(9)	C. H. Davis "National Metals Handbook", 1933, p. 1231.
54	(10)	H. B. Pulsifer "Smoothing and Etching Cupro-Nickel, Bronze, Brass and Steel", Trans. Inst. Metals Division A. I. M. M. E. p. 291 (1929).
62	(11)	W. Rosenhain "Introduction to the Study of Physical Metallurgy", D. Van Nostrand Co., Inc., New York (1914).
56	(12)	F. Adock "Internal Mechanism of Cold Work and Recrystallization", Jr. Inst. Metals (British) Vol. 27, p. 74 (1922).
	(13)	G. W. Pirk "The Technique of Examining Metals Under the Microscope, Part I", General Electric Review, Vol. XXVIII, No. 8, p. 573, (1925).
	(14)	G. W. Pirk "The Technique of Examining Metals Under the Microscope, Part II", General Electric Review, Vol. XXVIII, No. 11, p. 800 (1925).

TABLE III

Reference No.	Now is	
19	(15)—	M. G. Yatsevitch "Essential Factors in Conducting Macroetching Test Under Usual Practical Conditions of Production Work", Trans. A. Soc. Steel Treating, Vol. 21, p. 310, (1933).
	(16)	F. F. Lucas "On the Preparation of Iron and Steel Specimens for Microscopic Examination", Trans. Am. Soc. Metals, Vol. XXIV, p. 1, (1936).

END OF PART III

Part I—Method of selecting sample, cutting the specimen, mounting and polishing the specimen, was published in August.

Part II—Etching Steel and Copper, was published in the September issue.

PROCEEDINGS AND DISCUSSIONS OF THE 1936 WIRE ASSOCIATION MEETINGS

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The Wire Association

17 E. 42nd St. New York, N. Y.

Adhesion of Galvanized Coatings On Steel Wire

By Ernest H. Lyons, Jr., Chemist
The Meaker Company, Chicago, Ill.

A description of a new electro-galvanizing process with accurate control of coating thickness, simplified cleaning operation, high ductility and perfect adhesion at low cost. ✦ ✦ ✦

IN applying zinc coatings to steel, good adhesion is important, for if any considerable area of steel is laid bare by cracking, peeling, or flaking, it will rust in spite of the strong electrolytic protection exerted by the zinc. The remaining zinc then undergoes accelerated corrosion and complete failure of the galvanizing is thereby hastened.

✦ ✦ ✦

GOOD adhesion results from placing the zinc coating so close to the atoms of the steel surface that interatomic forces of attraction become effective.[1] The galvanized article then consists of one piece, largely steel, with a zinc coating, and a region of bonding and alloying between the two metals.

✦ ✦ ✦

A deposit of zinc on steel may be conceived as showing a sharp boundary with steel on one side, and zinc on the other, the boundary constituting a line of demarcation drawn between the atoms of the two metals. Such a boundary region may be considered as peculiar, nearly two - dimensional alloy, of molecular thickness. It would accordingly not correspond in its properties with a similar alloy having ordinary crystalline thickness, where quasi-surficial properties are insignificant.

✦ ✦ ✦

THIS rather idealized condition may obtain for an instant in hot-dip galvanizing; but at the temperatures involved, the metals rapidly diffuse, dissolve, and form several iron-zinc compounds. On cooling, the zone of crystallized compounds and diffused metals occupies a very considerable thickness often extending to the outer surface. Its structure is complex, and its properties largely depend upon the particular type of structure obtained.

✦ ✦ ✦

IT is not possible to apply a hot-dip coating without obtaining this broad zone of bonding. In it are apt to be more or less large and brittle crystals which constitute a point of weakness during mechanical stress and twistings, bendings, and other workings of the wire. It is questionable if this zone does not corrode more rapidly in atmospheric exposure than the purer portions of the zinc coating.

✦ ✦ ✦

ELECTRODEPOSITED coatings show a much sharper zone of bonding. At our present state of knowledge, or lack of it, the initial conditions of the electrodeposit are unknown; however, diffusion is negligibly slow at the temperatures used, and the bonded, alloyed layer may be only a few molecules thick. Occupying only a small fraction of the total thickness of the coating, this zone is often too narrow to be distinguished under the microscope.

✦ ✦ ✦

THE adhesion of a zinc deposit on a film of oxide or other foreign matter is determined by the adhesion of the oxide to the steel, the adhesion of the zinc to the oxide, and

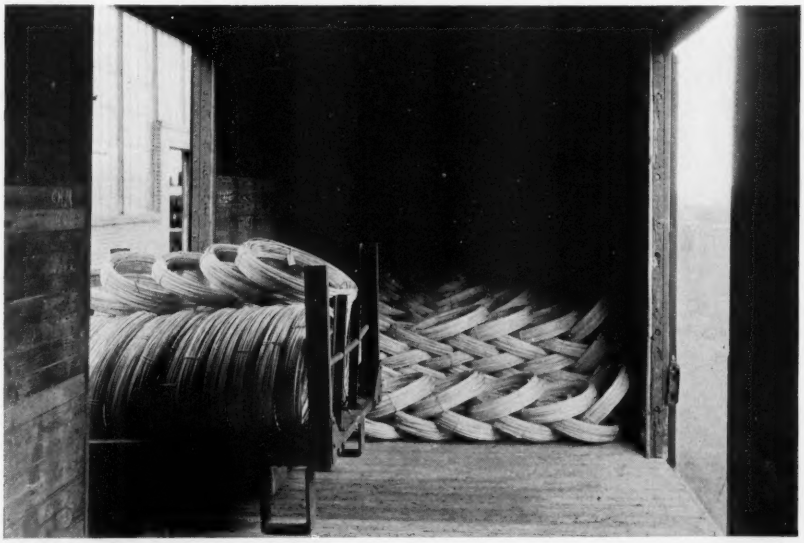

Figure 1. Photo by Courtesy of John A. Roebling's Sons Co. ✦ ✦ ✦ ✦

1—Keying of the coating into etched or roughened steel surfaces is also valuable. See, for example, J. M. Cosgrove, the Electrodeposition of Nickel on Zinc, Proceedings of the American Electro-Platers Society, 1936, p. 267.

the cohesion and thickness of the oxide.

✦ ✦ ✦

WHILE in the future we hope to explain and predict these forces or their differences, at present practical results indicate that the two adhesive forces are weak and the oxide itself is usually brittle. If a zone of oxide interposes between the steel and zinc, the bonding is always weak and the overall adhesion is poor.

✦ ✦ ✦

WITHIN a metal, the attractive forces or valence bonds of the metal atoms are satisfied or saturated by the surrounding atoms. On the surface, however, there is always some degree of unsaturation due to the absence of metal atoms outside the surface. Such unsaturation accounts for the peculiar properties of a surface. These surface bonds may be saturated, at least in part, by a film of absorbed oxygen. The oxygen bonds are largely satisfied by the metal atoms to which they cling, and this may explain the weak bonding and poor adhesion of the oxide-zinc bond. It would be interesting to determine if the oxygen atoms in such a film reorient themselves when a zinc deposit is applied.

✦ ✦ ✦

IN any case, removal of oxides and other impurities is essential to secure a good, tight coating of zinc. This is customarily accomplished by pickling, or the soaking of the surfaces in acid. While some oxides are only slowly dissolved by acid, the underlying metal is attacked and the oxide film is either undermined or pried off by bubbles of hydrogen gas which is evolved.

✦ ✦ ✦

PICKLING however does not thoroughly clean the surface of steel wire, apparently because drawing compounds and other foreign matter are embedded and incorporated into the steel surface by the severe physical work of the drawing operation. Many drawing compounds are resistant to chemical attack, particularly after the drawing operation, and remain absorbed on the steel with unusual tenacity, giving rise to poor adhesion when the zinc coating is applied. The use of a molten lead bath for annealing aggravates this condition.

✦ ✦ ✦

IN hot galvanizing some degree of adhesion is afforded by the partial removal of this dirt by the flux. As already explained, however, the adhesion of a hot-galvanized coating suffers from the formation of brittle compounds or structures due to the diffusion and alloying of the steel with the zinc, so that in severe bending and forming the coating cracks and may flake off.

✦ ✦ ✦

IT has long been recognized that electrogalvanizing avoids these difficulties, and, when properly applied to a thoroughly clean surface, results in perfect adhesion and superior resistance to corrosion.

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TO clean steel wire thoroughly with adequate rapidity, and to deposit zinc at rates approaching those of the hot-dip process, has been the object of many researches. Dr. U. C. Tainton[2] attacked the cleaning problem by treating wire cathodically in a bath of fused alkali, whereby oxides are reduced and foreign matter is destroyed or removed. This method, sometimes called the "nascent sodium method" due to the transient deposition of metallic sodium on the wire, is used in the Bethanizing Process of electrogalvanizing. It has been found desirable to supplement it with an electrolytic pickle.

✦ ✦ ✦

THE Meaker cleaning process follows the pickle by an electrolytic flash and appropriate after-treatment, laying bare a clean steel surface, ideally suited for electro-deposition, and perfectly free from foreign matter and oxides. Although the reagents used are not extremely corrosive, the cleaning action is vigorous and certain even when the baths are nearly depleted. As high temperatures are not employed, spring wire may be cleaned and galvanized as well as ordinary types.

✦ ✦ ✦

THOUGH installations of electrogalvanizing plants for round wire have been made in Europe by the Langbein-Pfanhauser Works of Germany, little information is available as to their methods of cleaning.[3]

✦ ✦ ✦

UNFORTUNATELY the extreme difficulty in cleaning has tended to divert attention from the equally serious problem of the deposition of zinc in a compact, satisfactory form at high rates of speed. The rate of deposition depends on the current density applied. In the early days of electrogalvanizing, 10 amperes per square foot was considered a high current density. It took about an hour to deposit one-half ounce of zinc per square foot of surface. To galvanize wire at this rate was obviously impractical.

✦ ✦ ✦

IN 1906 a new type of solution was introduced by Guy L. Meaker which operated at current densities up to 70 amperes per square foot. Since for many articles this was a practical rate of deposition, electrogalvanizing began to receive its first extensive industrial application.

✦ ✦ ✦

A DEVELOPMENT of this solution adapted to the peculiar needs of round wire is used in the Meaker Process. Brilliant, dense, non-porous deposits are obtained at current densities ranging up to 1500 amperes per square foot. Because the zinc is smooth, compact, and attractive as deposited, no finishing processes are needed. At these current densities, the speed of electrogalvanizing is comparable to that of the hot-dip methods.

✦ ✦ ✦

PROPERLY deposited zinc coatings are of extreme purity and ductility. Applied to perfectly clean steel, they cling and adhere through the most drastic tests. Even if the wire is so sharply bent or twisted that the steel itself frac-

(*Please turn to page 674*)

2—The Iron Age, April 23, 1936.

3—See Arnold Weisselberg, "Electrogalvanizing of Round Wire", Wire and Wire Products, Vol. 11, p. 287, June 1936.

Outstanding Personalities of the Wire Industry

Westinghouse Elects Bucher Executive Vice President

AT a meeting of the Board of Directors of the Westinghouse Electric and Manufacturing Company, George H. Bucher was elected Executive Vice President of the Company with headquarters at Pittsburgh, Pennsylvania. Mr. Bucher is also President and General Manager of the Westinghouse Electric International Company.

✦ ✦ ✦

MR. Bucher has been connected with the Westinghouse organization since September 1, 1909. After graduating from Pratt Institute, Brooklyn, in both steam and machine design and also electrical engineering, Mr. Bucher joined the Westinghouse Electric and Manufacturing Company at East Pittsburgh as a graduate student. In 1911 he was transferred to the Export Department in New York.

✦ ✦ ✦

IN 1920, he was appointed Assistant to General Manager of the Westinghouse Electric International Company, and a year later, 1921, he was made Assistant General Manager, which position he held until 1932, when he was elected Vice President and General Manager. In 1934 he was elected President and General Manager of the same Company, and in 1935 he was elected Vice President of the Westinghouse Electric and Manufacturing Company.

✦ ✦ ✦

MR. Bucher is a member of the A. I. E. E., the Engineers Club, National Foreign Trade Council and India House.

✦ ✦ ✦

Charles F. Kintzing, Head of the Essex Wire Cloth Company in Belleville, N. J.

CHARLES FENTON KINTZING, president of the Essex Wire Cloth Company here, died recently. Mr. Kintzing, who was in his fifty-fifth year, had established and managed several similar plants in different parts of the United States and Canada.

HE came here in 1914 as manager for the Rogers Wire Works and when that concern went out of business about fifteen years ago, he established the Essex Wire Cloth concern. Mr. Kintzing, who was born in Lock Haven, Pa., was a charter member of the Rotary Club of Belleville.

✦ ✦ ✦

F. P. McEwen Assistant Sales Manager, Republic Steel's Upson Division

FRANK P. McEwen, formerly southern sales manager of Oliver Iron & Steel Corporation, has been appointed assistant manager of sales, with headquarters in Cleveland, of the Upson division of Republic Steel Corporation, according to an announcement by N. J. Clarke, vice president in charge of sales. This division is concerned with the manufacture and sale of bolts and nuts.

✦ ✦ ✦

MR. McEwen was born in Nashville, Tenn., and his first connection was with the Nashville, Chattanooga and St. Louis Railroad in the freight department. He left there in 1912 to become commercial agent in charge of solicitation of the Clinchfield Railroad.

✦ ✦ ✦

HE enlisted in the Army in April, 1917, and was soon commissioned First Lieutenant in the 30th Division of the 115th Field Artillery. After spending 14 months in France, Mr. McEwen returned to the Clinchfield Railroad as general western agent. In 1928 he became district sales manager of Oliver Iron & Steel Corporation, and remained with that company until his recent appointment with Republic Steel Corporation.

✦ ✦ ✦

M. W. McDonald, Secretary and Treasurer Dominion Steel & Coal Corp., Ltd.

M. W. McDonald, comptroller, Dominion Steel & Coal Corp., Ltd., Sydney, N. S., has been appointed secretary and treasurer, succeeding C. S. Cameron, who is resigning because of ill health. Mr. Cameron will continue as a director and vice president of the company. Chris. Spiers succeeds Mr. McDonald as comptroller.

✦ ✦ ✦

Henry D. Scott Assistant to President Wheeling Steel Corporation

HENRY D. SCOTT has returned to the Wheeling Steel Corporation to become executive assistant, and **J. H. McElhinney,** formerly of Coatesville, Pa., assumes the duties of assistant to the vice president, and **George W. Hewitt** has been made director of the raw materials division of the corporation.

✦ ✦ ✦

THESE executive changes come with the announcement of the resignation of Parker F. Wilson, effective September 30th. Mr. Wilson was assistant to the President.

✦ ✦ ✦

MR. SCOTT was identified with the operating department of the corporation in an executive capacity until a few years ago when he organized the Sharon Tube Company and moved to Sharon, Pa.

✦ ✦ ✦

MR. McElhinney comes to Wheeling from the Lukens Steel Company, Coatesville, Pa., where he was general superintendent. Mr. McElhinney graduated from the University of Pittsburgh in 1909 and was engaged in power house construction for two years; in 1911 he entered the employ of the United Engineering & Foundry Company and two years later joined the Youngstown Sheet & Tube Company; after service in the World War he was identified with the Columbia Steel Company as consulting engineer. He was with Lukens Steel Company since 1926 and became general superintendent in 1929.

The Paper Entitled
"Vacuum Lead Sheath as Applied to Power Cable"
By R. W. Atkinson
Presented Before The Wire Association Meeting
Will be Published in the December, 1936 issue of
WIRE AND WIRE PRODUCTS

Exports and Imports of Wire

Exports of Iron and Steel Wire Products in August, 1936 and Aug., 1935
(In gross tons)

	August 1936	July 1936	August 1935
Wire rods	2,533	2,132	2,692
Hoops, bands and strip steel	4,906	6,052	3,856
Plain black or galvanized iron or steel wire	3,264	3,702	3,900
Barbed wire and woven wire fencing	2,586	3,367	3,801
Woven wire screen cloth	65	134	96
Wire rope	151	291	260
Insulated iron or steel wire and cable—see analysis below			
Other wire and manufactures	444	460	399
Wire nails	431	772	962
Tacks	34	31	32
Other nails, including staples	212	141	236
Bolts, machine screws, nuts, rivets and washers	492	464	469
Total, these 11 classifications	15,118	17,546	16,703

Imports of Iron and Steel Wire Into the United States
(In gross tons)

Concrete reinforcement bars	26,048	9,036	14,750
Hollow bars and drill steel	26,457	18,665	14,464
Wire rods	138,915	75,811	58,427
Barbed wire	60,584	54,233	80,884
Round iron and steel wire	82,112	59,738	41,392
Telephone and telegraph wire	248	220	291
Flat wire and strip steel	157,434	103,343	140,663
Wire rope and strand	28,147	32,525	25,414
Other wire	9,818	6,451	6,213
Hoops and bands	84,887	64,828	42,525
Nails, tacks, and staples	107,458	147,291	122,069
Bolts, nuts and rivets	5,748	4,043	1,589
Total, these 12 classifications	727,856	576,184	548,681

Exports of Insulated Wire and Cable, August, 1936

	Foreign		To U. S. Possessions	
	Pounds	Dollars	Pounds	Dollars
Insulated iron or steel wire and cable	10,173	$ 2,053	4,572	$ 1,065
Rubber-covered wire	346,764	71,524	39,001	11,090
Copper weatherproof wire	155,139	20,186	35,698	4,846
Copper telephone cable	10,336	1,890	150	140
Other insulated copper wire	234,810	49,873	134,385	19,357
Nickel-chrome electric resistance wire	32,293	41,145	.....	.....
Total, these 6 classifications	789,515	$186,671	213,806	$36,498

Imports Upward

IMPORTS of iron and steel products (excluding scrap) were at an accelerated rate in August, the volume stepping up to 48,179 tons valued at $2,092,517 to top the trade in July by 25.6 percent in quantity and 33 percent in value. When compared with the August 1935 totals, respective increases of 61 percent and 50.5 percent were registered. Aggregate receipts during the first 8 months of the current year totaled 339,575 tons valued at $13,756,886, and were substantially greater (47 percent in volume and 35.4 percent in value) than in the identical period of 1935.

✦ ✦ ✦

Exports Remain at High Level

IRON and steel shipments were higher in 33 classifications—August compared with July—and lower in 33. The outstanding decline was recorded in black steel sheet exports, which for some months have been at an extremely high level. This decline (8,973 tons), was followed by those recorded in ingots (2,912), hot-rolled strip steel (1,189), tin plate (1,369), and welded galvanized steel pipe (905). The chief increase was registered in heavy rails (6,623), offsetting considerably the lower trade in black steel sheets. Next came that registered in skelp (2,256), followed by seamless casing and oil-line pipe (993), rail joints (708), and unlined tanks (656).

✦ ✦ ✦

NOTWITHSTANDING its lower total—when compared with July—tin plate resumed its rank as the chief item of export within the semi-finished and finished steel group, a total of 14,641 tons going mostly to Brazil (1,818), Soviet Russia (1,577), the Netherlands (1,545), Japan (1,276), and Mexico (1,178). Next came heavy rails (11,768 tons), which were chiefly purchased by Mexico (6,759), Brazil (3,460), and Canada (1,542). Black steel sheets aggregating 7,115 tons found numerous markets, in which the outstanding were Canada (2,076), Soviet Russia (1,430), and Mexico (905). Skelp (5,657 tons)—the next item—went principally to Canada (5,578). Plain shapes (5,226 tons), represented the fifth item and was mostly taken by Canada (3,684), Cuba (481), and the Philippine Islands (288). 'Other plate' (6,740 tons)—in a widespread trade—for the most part went to Sweden (2,196), Canada (859), Iran (636), and Mexico (433).

✦ ✦ ✦

Canada Maintains First Ranking As Individual Market

CANADA'S imports of iron and steel products from the United States at 22,196 tons represented the highest total (excluding scrap) shipped to any individual market during the reviewed month. The outstanding products were skelp (5,578 tons), plain shapes (3,684), 'other steel bars' (2,144), black steel sheets (2,076), hot-rolled strip steel (1,713), and heavy rails (1,542). Sales to Mexico increased in the month, the outstanding products in a total trade of 13,681 tons being heavy rails (6,759), tin plate (1,178), black steel sheets (905), cast-iron pressure pipe and fittings (476), 'other plate' (433), and unlined tanks (426). Brazil was the third market with aggregate purchases of 7,627 tons, comprised mostly of heavy rails (3,460), tin plate (1,818), and plain wire (716). Next came the Philippine Islands, which received a total of 5,977 tons, mainly of galvanized steel sheets (1,749), cast-iron pressure pipe (890), tin plate (730), 'other steel bars' (490), black steel sheets (487), and plain shapes (288). Cuba's trade (4,776 tons) was next, the bulk of which being

represented in tin plate (1,011), black steel sheets (753), plain shapes (481), and barbed wire (473). Soviet Russian purchases —next in importance—aggregated 4,110 tons and were confined chiefly to tin plate (1,577), black steel sheets (1,430), hot-rolled strip steel (699), and seamless boiler tubes (277).

✦ ✦ ✦

Sharp Rise in August Imports

AUGUST receipts of iron and steel products (excluding scrap) at 48,179 tons gained sharply (25.6 percent) over the July total. Compared with August, 1935, the rise was considerably more (61 percent). The outstanding increase was registered in structural shape imports (3,976 tons), which were practically all in the "plain" category. Following came 'other pipe' (1,476), spiegeleisen (1,238), solid or hollow bars (1,104), sheets, skelp, and sawplate (743), and concrete reinforcing bars (648). Sheet piling recorded the most conspicuous decline (943 tons), followed by rails and track material (317), 'other' ferro-alloys (275), and sponge iron (252). All in all—comparing August with July — a higher volume of trade occurred in 25 classifications, counterbalanced by declines in 11. No trade occurred in 1 (iron slabs), while in another (telegraph and telephone wire) it remained constant.

✦ ✦ ✦

Pig Iron Maintains Leading Role in Import Trade

AGAIN pig iron was the leading item of import within the iron and steel group from a tonnage standpoint, a total of 12,424 tons coming in mostly from the Netherlands (5,837), British India (5,038), and Canada (692). Structural shapes—practically all plain—followed with an aggregate of 7,264 tons, being received chiefly from Belgium (5,305), and France (1,868). All of the spiegeleisen received (5,249 tons) originated in Canada, while solid or hollow bars totaling 3,557 tons—the next item of importance—came principally from Belgium (2,591), France (455), and Sweden (357). 'Other pipe' (3,384 tons) followed, the chief countries of supply being Germany (2,731), Sweden (420), and Poland (201). The bulk of 'other hoops and bands'—received to a total of 2,683 tons—came in from Belgium (1,826), France (534), and Germany (293). Sheets, skelp, and sawplate was the sixth item of importance with an aggregate of 2,062 tons, and came mostly from Belgium (1,231), Germany (616), and France (110).

✦ ✦ ✦

AGAIN the import trade in **card clothing** recorded a decline, total receipts of 22,025 square feet valued at $30,620, falling 33.4 percent in quantity and 34.6 percent in value when compared with those coming in during July. The suppliers were the United Kingdom (17,361 square feet and $21,448), Germany (3,487 square feet and $7,202), and Belgium (1,172 square feet and $1,970).

(*Please turn to page 675*)

MICROMETER PRECISION MICRO-WELD TRADE MARK REG. U. S. PAT. OFF.

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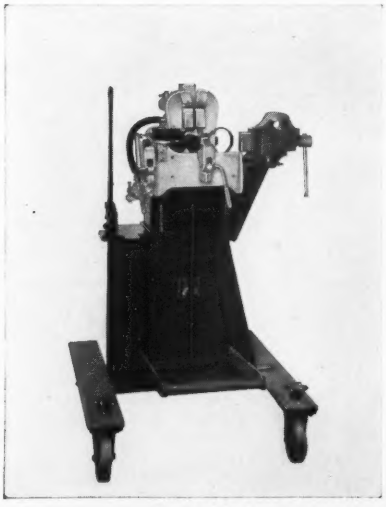


MICRO PRODUCTS COMPANY
20 NORTH WACKER DRIVE, CHICAGO, ILL.
Telephone State 7468 General Office and Factory, Peoria, Ills.

A Review of Recent Wire Patents

No. 2,052,553, STAPLE, Patented September 1, 1936 by John F. Cavanagh, Providence, R. I., assignor to Boston Wire Stitcher Company, Warwick, R. I., a corporation of Maine.

This staple is of the kind employed for securing together sheets of paper and the like. The top or head of the wire staples are crowned in such a manner that, it is claimed, the strength is materially increased.

✦ ✦ ✦

No. 2.052,982, SPRING ASSEMBLY, Patented September 1, 1936 by David I. Levine, Lynn, Mass., assignor to Lisson & Melen Company, Lynn, Mass., a Corporation.

In this spring assembly, the inventor has provided a construction so that the springs will not rotate with respect to each other and are substantially noiseless.

✦ ✦ ✦

No. 2,053,221, WIRE NETTING LOOM, Patented September 1, 1936 by Harry L. Kitselman, Muncie, Ind., assignor to Indiana Steel & Wire Company, Muncie, Ind., a corporation of Indiana.

For the construction of netting, such as poultry netting, the loom has been provided for weaving the wire so that all the locks will have the same number of turns or twists.

✦ ✦ ✦

No. 2,053,260, WIRE FEEDING MECHANISM, Patented September 8, 1936 by Arthur Ernest Blashill, Withington, Manchester, England.

This patent is related to patent 1,996,-061, granted April 2, 1935 to the same inventor. The wire is fed continuously and severed while being fed.

✦ ✦ ✦

No. 2,053,411, APPARATUS FOR APPLYING WINDINGS TO FILAMENTS, Patented September 8, 1936 by Herman Zarafu, West New York, N. J.

Wrapping material is supplied from a rotating coil, traversed by the wire filaments.

✦ ✦ ✦

No. 2.053,645, STRAND HANDLING APPARATUS, Patented September 8, 1936 by Leo L. Weaver, Cranford, N. J., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York.

This apparatus is adapted for twisting wire strands together in pairs and then twisting together two or more pairs.

✦ ✦ ✦

No. 2,053,764, WINDING AND COIL BINDING MACHINE, Patented September 8, 1936 by Penrose E. Chapman, St. Louis, Mo.

The construction includes a turret and a number of winding elements mounted upon the turret in such relation to each other that, as the turret is indexed, the wire extending between its source of supply and a coil wound by one of the winding elements, will be in the indexing path of a succeeding element, and come into such a position with this succeeding element that the wire extending between the elements may be used for coil leads.

Complete Descriptions and Drawings of Patents May Be Had for 25 cents. Address, Wire & Wire Products, 17 East 42nd St., New York.

No. 2,054,010, COMMUNICATION CABLE. Patented September 8, 1936 by Ernst Fischer, Berlin-Lichterfelde, Germany, assignor to Siemens & Halske Aktiengesellschaft, Siemensstadt, near Berlin, Germany, a corporation of Germany.

This cable comprises a number of individually air spaced wire conductors, each conductor having an individual insulating as well as insulating spaces for supporting the insulating in spaced relation on the conductor. All or a majority of the insulating elements comprise, at least partly, a practically non-hygroscopic rubbery substance, having smaller dielectric losses than paper at high frequencies.

✦ ✦ ✦

No. 2,053,946, APPARATUS FOR FEEDING WIRES, Patented September 8, 1936 by John F. Donovan and George Illingworth, East Cleveland, Ohio, assignors to General Electric Company, a corporation of New York.

More specifically, this apparatus is adapted for feeding the leading-in wires for electric incandescent lights.

✦ ✦ ✦

No. 2.054,061, WIRE DRAWING APPARATUS, Patented September 8, 1936 by John B. Moss, Providence, R. I., assignor to Kennecott Wire and Cable Company, a corporation of Rhode Island.

This inventor has provided a synchronized wire drawing and spooling arrangement for a wire drawing apparatus.

✦ ✦ ✦

No. 2,054,196, SPRING COILING MACHINE, Patented September 15, 1936 by Joseph Gogan, Lakewood, Ohio.

The machine is adapted for coiling relatively heavy wire into helical springs, employed particularly for individual wheel suspension in automobiles.

✦ ✦ ✦

No. 2,054,335, MACHINE FOR MANUFACTURING FISHHOOKS, Patented September 15, 1936 by Paul A. Nelson, Golden, Colo., assignor to Wright & McGill Co., Denver, Colo., a corporation of Colorado.

A machine is provided for manufacturing fishhooks from wire, the machine being adjusted to form the fishhooks of various shapes and sizes.

✦ ✦ ✦

No. 2.054,675, MACHINE FOR COILING FILAMENTS, Patented September 15, 1936 by George Illingworth and John F. Donovan, East Cleveland, Ohio, assignors to General Electric Company, a corporation of New York.

The assembly includes a shaft which receives a spool holding a quantity of mandrel wire, from which it is unwound and wound upon the mandrel with a uniform tension on the wire. Means is provided to rotate the shaft in the opposite direction from the rotation caused by the unwinding of the wire and, finally, the wire after the coiling operation is wound up by another portion of the machine.

No. 2,054,696, COIL WINDING MACHINE, Patented September 15, 1936 by Rodger J. Emmert, Dayton, Ohio, and Louis C. Goad, Muncie, and Russell W. Baker, Leo C. Shippy, John Q. Holmes, Alva W. Phelps and Charles E. Birch, Anderson, Ind., assignors, by mesne assignments, to General Motors Corporation, Detroit, Mich., a corporation of Delaware.

This machine is adapted for disposing paper about the wire.

✦ ✦ ✦

No. 2,054,718, CONTINUOUSLY LOADED CONDUCTOR, Patented September 15, 1936 by Manvel Keeport Zinn, Brooklyn, N. Y., assignor to American Telephone and Telegraph Company, a corporation of New York.

Loading material is provided for this wire conductor and comprises two or more different materials, these materials being applied in periodic sequence to successive lengths of the wire conductor.

✦ ✦ ✦

No. 2.054,813, WOVEN WIRE FABRIC AND METHOD OF MAKING THE SAME, Patented September 22, 1936 by Raymond J. Guba, Philadelphia, Pa., assignor to Audubon Wire Cloth Corporation, a corporation of N. J.

The method consists in providing a section formed of transversely extending helical wires twisted in the same direction into interlocking engagement, providing another section formed of transversely extending helical wires twisted in the opposite direction into interlocking engagement, placing the coils of an end wire of one section in overlapping engagement within the coils of an end wire of the other section, and threading a helical wire through the coils of the first mentioned end wire.

✦ ✦ ✦

No. 2,054,868, BEDSPRING, Patented September 22, 1936 by Jacob Schwartzman, Brooklyn, N. Y.

The inventor employs a number of double, inverted cone-shaped, spiral springs supported on the cross bars of the bed spring structure and having their lower ends attached thereto and a number of straps placed diagonally across the upper ends of the spiral springs and secured thereto, the straps being also secured to the end members of the frame structure.

✦ ✦ ✦

No. 2,055,223, INSULATED WIRE, Patented September 22, 1936 by Leon Robbin, New Rochelle, N. Y., assignor to Vega Manufacturing Corporation, Wilmington, Del., a corporation of Delaware.

More specifically, the invention lies in the provision of an insulating coating for the wire conductor comprising a mixture of a finely divided inorganic insulating material, a rubber-oil-resin binder and a boron compound.

✦ ✦ ✦

No. 2.055,155, FEED COLLET FOR AUTOMATIC SCREW MACHINES, Patented September 22, 1936 by Alexis Naert, Detroit, Michigan.

The construction includes a tubular body having a screw threaded portion at one end with a semi-cylindrical jaw

A Review of Recent Wire Patents

extending from the other end and reinforcing fillets formed at the juncture of the tubular body and semi-cylindrical jaw. A second complimentary semi-cylindrical jaw co-acting with the first jaw to engage stock extending between the jaws and through the tubular body is provided, with a relatively wide split spring band encircling the jaws.

✦ ✦ ✦

No. 2.055,444, ANTINOISE STRUCTURE, Patented September 22, 1936 by Arthur W. Kimbell, Newton Center, Mass., assignor to United-Carr Fastener Corporation, Cambridge, Mass., a corporation of Mass.

The invention appears to lie in the construction particularly of clips for attaching portions of the tufting to the frame, the clips having particles of material to prevent noise when the clips contact the springs.

✦ ✦ ✦

No. 2,055,750, WIRE ROPE CENTER, Patented September 29, 1936 by James B. Reber, Auburn, N. Y., assignor to Columbian Rope Company, Auburn, N. Y., a corporation of New York.

The center of this wire rope consists of a number of elongated, unspun fibers, having a low degree of twists and considerable softness and flexibility. The fibers are impregnated with a stabilizing agent, such as latex compounds.

✦ ✦ ✦

No. 2,055,754, UPHOLSTERY SPRINGS, Patented September 29, 1936 by Jacob Schwartzman, Brooklyn, N. Y.

It is stated by this inventor that the ends of the wire spring need not be twisted around the last convolution, as is customary. It is stated that less padding will be required with the construction disclosed.

✦ ✦ ✦

No. 2,055,948, ELECTRICAL CONDUCTOR AND PROCESS OF MAKING THE SAME, Patented September 29, 1936 by Rolf Selquist, McKeesport, Pa., a corporation of Pa.

An electrical conductor is provided for transmission lines where the spacing of the towers or supports requires a high tensile strength. It is claimed that this conductor combines the advantageous features of an all-copper conductor and the bimetallic cables.

✦ ✦ ✦

No. 2,056,017, HIGH TENSION OIL-FILLED CABLE, Patented September 29, 1936 by Carl A. Piercy, Ballston Lake, N. Y., assignor to General Electric Company, a corporation of N. Y.

The inventor provides a tinned wire core with tinned wrapping in the construction of an oil filled cable. It is stated that the formation of copper soap is prevented by the provision of the tinned wires and tinned wrapping.

✦ ✦ ✦

No. 2,056,028, MACHINE FOR MAKING COILED-COILS, Patented September 29, 1936 by Sten Wadsten, Bloomfield, N. J., assignor to Westinghouse Lamp Company, a corporation of Pa.

This machine is provided for making coiled wire coils after the method set out by R. H. Bebbe in U. S. patent 2,-013,432, dated September 3, 1935.

✦ ✦ ✦

No. 2,056,053, METHOD OF MAKING HEADLESS SCREWS, Patented September 29, 1936 by George A. Moore, Boston, Mass.

A rough thread is cut on long pieces of rod or wire stock and is then fed into the machine which finishes the thread.

✦ ✦ ✦

No. 2,056,085, ELECTRIC CABLE, Patented September 29, 1936 by John J. Alles, Wilkes-Barre, Pa.

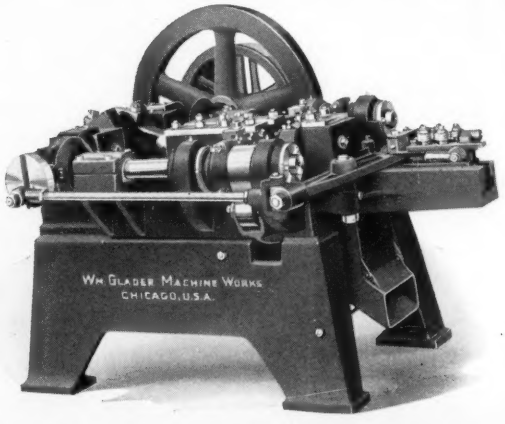
More specifically, the inventor provides an electric conductor so constructed as to detect faults, such as due to electrolysis, before moisture has reached the conductor beneath the insulation.

✦ ✦ ✦

No. 2,056,130, INSULATED ELECTRICAL CONDUCTOR, Patented September 29, 1936 by Arthur Stanley Watson, Norton, Mass., assignor to General Cable Corporation, New York, N. Y., a corporation of N. J.

The conductor is especially adapted for exposed positions, such as on pole lines, and comprises, next to the wire conductor, a coating of rubber, then matted fiber, which is treated with a bituminous saturant, then fiber is laid which is similarly treated, and an outer coating of a non-sticky material.

HIGH SPEED WIRE NAIL MACHINE



WM. GLADER MACHINE WORKS

210 N. Racine Ave., Chicago, Illinois

The production figures shown below are guaranteed, but without exception they are exceeded in general mill practice.

SIZE MACH.	SIZE WIRE	MAX. LENGTH OF NAIL	NUMBER OF NAILS PER MIN.	CAP. IN POUNDS PER HR.
#00	#14	1¼"	550	55
#0	#12	1¾"	450	89
#1	#10	2½"	400	192
#2	#8	3½"	325	310
#3	#4	5"	225	523
#4	#1	7"	190	622
#4s	5/16"	9"	175	1155
#5	3/8"	12"	160	2400

This high output and economical operation account for the GLADER machine being accepted as standard equipment in all recent installations.

'Round the World With the Wire Industry

German Notes

THE general situation in the wire export market, particularly in wire nails and wire netting, continues satisfactory. However, most of the other wire products are slower. The German wire nail manufacturers report the domestic demand for wire nails this year has exceeded 1926 and 1928 and is continuing, due to the unusually good building season. No change in prices has occurred within the past four weeks except in wood screw prices which were reduced for export to the Far East. The demand for wood screws is very heavy. Export figures are rising even though Japanese competition grows keener. United States has placed a few more important orders for barbed wire, but has purchased less wire nails than in the preceding months. Portugal bought heavier quantities of barbed wire. A barter agreement with Italy concerns supplies of 1,000 tons of wire ropes and steel cables to Ethiopia.

✦ ✦ ✦

GREAT BRITAIN and Japan have bought recently large quantities of wire making machinery; chiefly barbed wire, wire nail and fine wire drawing machines. Russland is also buying in spite of the political tension.

✦ ✦ ✦

PRICES for wire mesh for the 50 x 2′ reel are as follows (for yellow, green or blue painted quality):

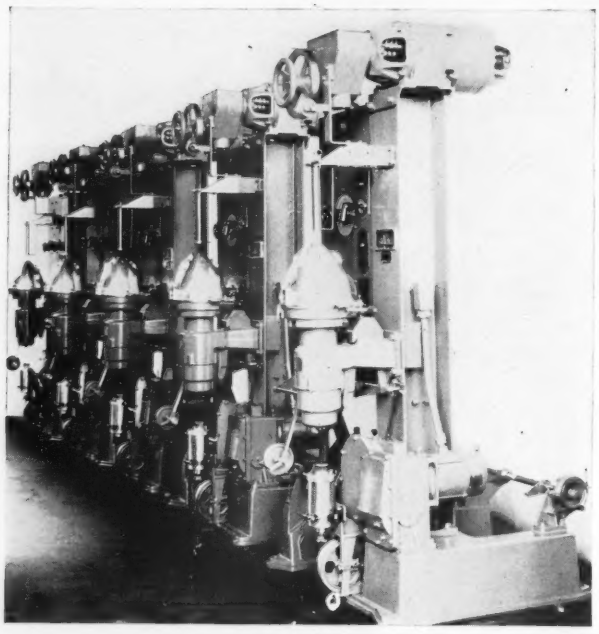
12 mesh (12 mesh on 1") 5/3 shillings.
14 mesh 6 shillings.
16 mesh 6/6 shillings.
18 mesh 7/3 shillings.
20 mesh 8 shillings.
24 mesh 8/9 shillings.

✦ ✦ ✦

THE thinner gauges are correspondingly dearer and the enamelled quality is approximately 15 to 20% dearer. Hard quality is sold at an extra cost of 15 to 20%. Prices for non-ferrous metal mesh range between 16 to 26 shillings for 14 to 18 mesh. Phosphor bronze mesh is the chief product in demand on the export market. The demand for aluminium and monel metal mesh is very satisfactory. The latter is bought by South African, Rhodesian, Canadian and Australian gold mines.

✦ ✦ ✦

RESTRICTIONS concerning the building of new wire and wire products factories in Germany continue, and the same concerns the establishment of labor saving machines, which can be only established if the total number of workmen employed is maintained and none discharged. The total unemployment was 1,092,000 people at the end of August, 1936, of which about only 52% were "able bodied" men or women, the rest being disabled, old or otherwise. This total is about one-sixth of what it was three years ago and includes almost no men of the metal branches and the scarcity of skilled men is still greater. However, this fact has not led to a change of attitude by the Government.



SYNCRO INSULATING MACHINES

accurately serve wire with tape and strands at

ONE TURN PER INCH

Paper, Cellophane, cellulose acetate, etc. as well as celanese, cotton and silk are efficiently served with a Flyer speed variable from 2500 R. P. M. to 5000 R. P. M.

Further information gladly furnished.

SYNCRO

SYNCRO MACHINE COMPANY

187 SYLVAN AVE. NEWARK, N. J.

'Round the World With the Wire Industry

REPORTS that important outside quantities of wire products are at present available on the export market must be denied. As a matter of fact the quantities available are rather small and as a total will not exceed 3% of the sales made by the IWECO. Almost all of the outside wire business is concentrated in the hands of a few British export merchants who buy the wire f. o. b. Anvers. This, however, does not give any information as to the origin of the product.

✦ ✦ ✦

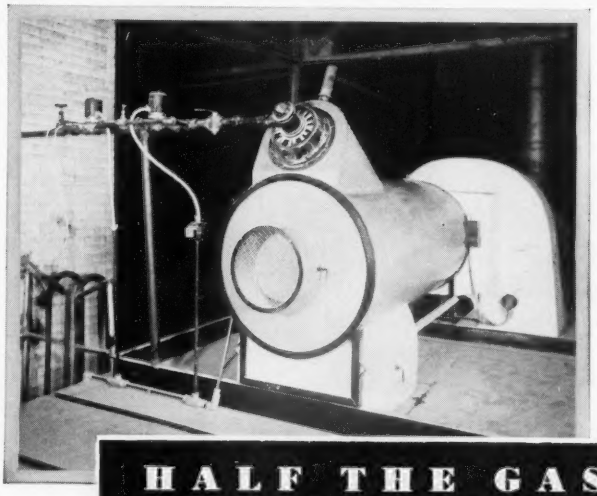
Development of Surface Alloying Process in England

CONSIDERABLE notice has recently been given to a surface alloying process said to have been developed in England by two Midland engineers, according to information from Consul James R. Wilkinson, Birmingham. From what has been published it appears that the engineers in question will establish a plant at Birmingham where the process will be employed and it is reported that already numerous industries have indicated that they will have the process applied to parts utilized by them in the construction of machines and apparatus of various kinds. The process is described as being comparatively simple, operating on an electro-chemical principle. Apparently, it is stated, a medium has been discovered which, if an electric current is passed through it under certain physical conditions, will break down into simple elements or compounds, the metal contained therein entering into alloy with a certain thickness of the metal at the surface of the object to be treated. For example, if the object treated is a sheet or iron and the metal in the medium is copper, the latter metal will not form a deposit on the iron sheet but will actually enter into the surface of the sheet of iron to form with the iron near the surface a true iron-copper alloy. It is being claimed that the process will almost revolutionize present practices adopted to prevent metal surfaces from rusting, and that it will solve the problem of rust under metal coatings deposited by ordinary electrolytic methods.

✦ ✦ ✦

Rumanian Firm Starts Horseshoe Nail Production

HORSESHOE nails are now produced by the "Metalloglobus" of Bucharest, **Rumania**, the only other firm in that country producing that article being Mustade & Fii of Galatz. The two firms have arrived at an agreement to the effect that the first named will furnish 30 per cent out of every horseshoe nail order, leaving 70 percent to the second named. Present prices average from 142 to 315 lei per 1,000 according to this report from Consul Frederick P. Hibbard, Bucharest.



HALF THE GAS— TWICE THE ROD

Profits derived from Morrison rod bakers start at this recirculating, convection heating unit. In combination with modern Morrison ovens, scores of such installations are establishing new records for profitable savings. Gas consumption has been cut as much as half. At the same time, hourly production has been stepped up—sometimes doubled. Efficiency goes in both directions at the same time. These are actual facts from field experience. What can we do for you?

Other Morrison equipment is designed for annealing, heat-treating, and galvanizing; tank and pot heating; and other industrial process heating applications utilizing the recirculating forced convection method.

MORRISON ENGINEERED

Morrison Engineering Company, Inc.

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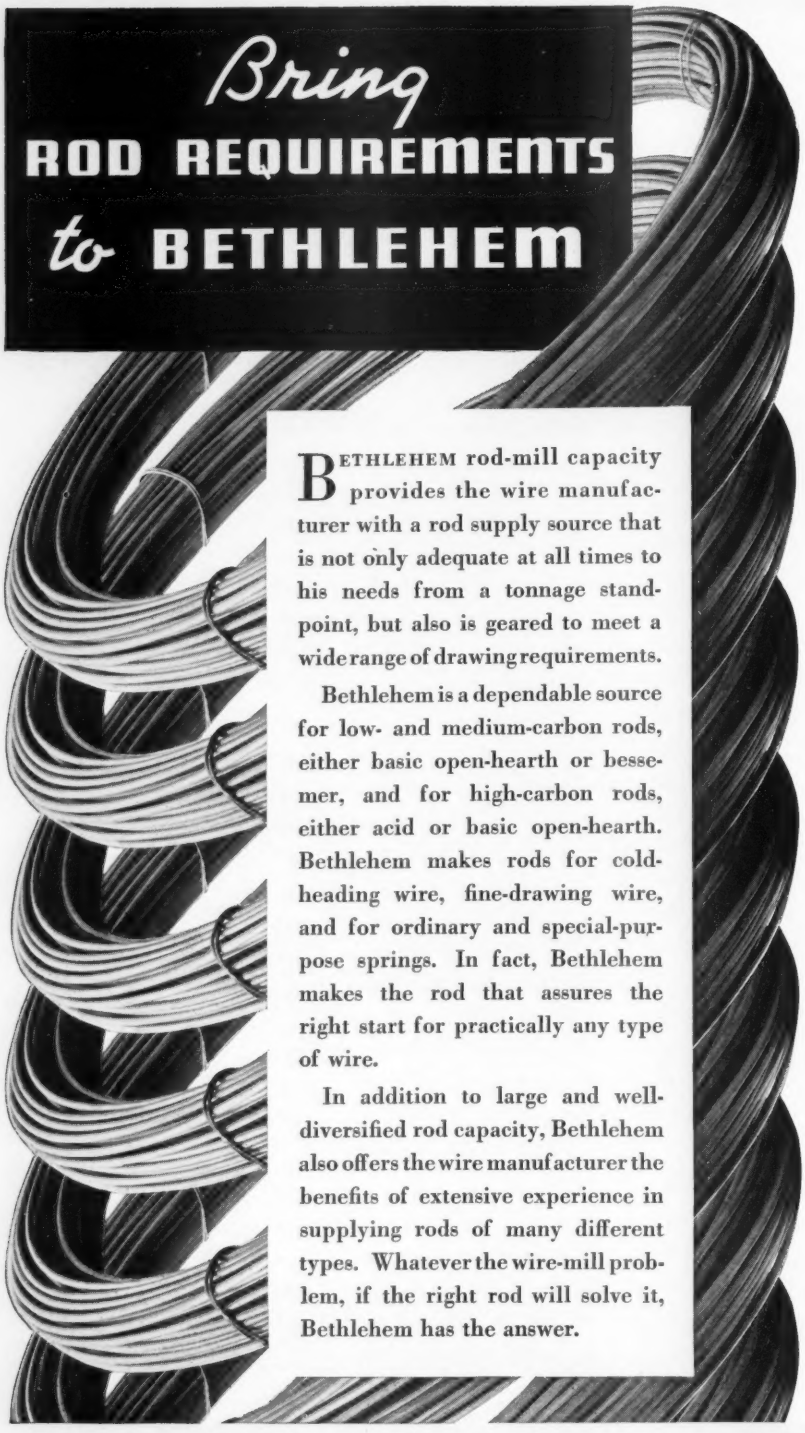
Bring ROD REQUIREMENTS *to* BETHLEHEM



BETHLEHEM rod-mill capacity provides the wire manufacturer with a rod supply source that is not only adequate at all times to his needs from a tonnage standpoint, but also is geared to meet a wide range of drawing requirements.

Bethlehem is a dependable source for low- and medium-carbon rods, either basic open-hearth or bessemer, and for high-carbon rods, either acid or basic open-hearth. Bethlehem makes rods for cold-heading wire, fine-drawing wire, and for ordinary and special-purpose springs. In fact, Bethlehem makes the rod that assures the right start for practically any type of wire.

In addition to large and well-diversified rod capacity, Bethlehem also offers the wire manufacturer the benefits of extensive experience in supplying rods of many different types. Whatever the wire-mill problem, if the right rod will solve it, Bethlehem has the answer.

Bethlehem District Offices are located at Albany, Atlanta, Baltimore, Boston, Bridgeport, Buffalo, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Honolulu, Houston, Indianapolis, Kansas City, Los Angeles, Milwaukee, New York, Philadelphia, Pittsburgh, Portland, Ore., Salt Lake City, San Antonio, San Francisco, St. Louis, St. Paul, Seattle, Syracuse, Washington, Wilkes-Barre, York. *Export Distributor:* Bethlehem Steel Export Corporation, New York.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

GENERAL OFFICES: BETHLEHEM, PA.

Wire Association Attendance List—1936 Meeting

(*Continued from Page 647*)

CLARK, E. W., Mechanical Eng.,
Wire & Cable Section,
General Electric Company,
Schenectady, New York.

CLARK, HERBERT B., Vice-Pres.,
Union Wire Die Corp.,
Cleveland, Ohio.

CLIFFORD, RALPH K., Gen. Supt.,
Continental Steel Corp.,
Kokomo, Indiana.

COCHRAN, I. G., Supt. Wire Mill,
Laclede Steel Company,
Alton, Illinois.

COHN, RALPH F.,
Pines Winterfront Company,
Chicago, Illinois.

CONWAY, FRANCIS J., Supt. Wire Mill,
Carpenter Steel Company,
Reading, Pa.

COOCH, L. S., Metallurgist,
Buffalo Bolt Company,
North Tonawanda, New York.

COPPICK, JOHN C., Manager,
Dominion Steel & Coal Corp.,
Montreal, Canada.

CORDES, HENRY G., Foreman,
Drawing Dept.,
Keystone Steel & Wire Co.,
Peoria, Illinois.

CORNELIUS, TAYLOR, Asst. Supt., Wire Mill,
Aluminum Co. of Canada, Ltd.,
Shawinigan Falls, P. Q. Canada.

COWAN, R. J., Metallurgist,
Surface Combustion Corp.,
Toledo, Ohio.

CRAWFORD, W. H., Manager,
Eaton Manufacturing Co.,
Massillon, Ohio.

CREWE, L. C., JR., Foreman Wire Mill,
Bethlehem Steel Company,
Sparrows Point, Md.

DENNIS, WALTER J., Sales Eng.,
Illinois Tool Works,
Chicago, Illinois.

DESCOMBES, LLOYD E., Supt., Wire & Spring,
International Harvester Company,
Springfield, Ohio.

DIMLING, PAUL E., Salesman,
Firth-Sterling Steel Company,
McKeesport, Pa.

DIMMICK, BLEES E., Supt. Die Dept.,
Keystone Steel & Wire Company,
Peoria, Illinois.

DUNKELBERGER, L. E., Plant Eng.,
Reynolds Wire Company,
Dixon, Illinois.

DUNSCOMB, RICHARD A., Sales Repr.,
WIRE & WIRE PRODUCTS,
New York, N. Y.

EATON, E. R., Jr., Mech. Eng.,
Steel Company of Canada, Ltd.,
Hamilton, Ontario, Canada.

ELDER, R. W., Mech. Eng.,
National Standard Company,
Niles, Michigan.

ELIAS, H. W., Asst. Manager,
Firthaloy Division,
Firth-Sterling Steel Co.,
McKeesport, Pa.

EVANS, BERNARD C.,
General Electric Company,
Fort Wayne, Indiana.

FARNSWORTH, WALTER B., Chief Metallurgist,
Pittsburgh Steel Company,
Monessen, Pa.

FISHER, E. J. P., Metallurgist,
Republic Steel Corp.,
Chicago, Illinois.

FOEGE, H. W., Sales Dept.,
Keystone Steel & Wire Co.,
Detroit, Michigan.

FOSBURG, H. A., Supt.,
The Meaker Company,
Chicago, Illinois.

FRYER, G. P., Supt.,
The R. H. Miller Co.,
Homer, New York.

FULLAGAR, W. W., Dist. Mgr.,
Carboloy Company, Inc.,
Chicago, Illinois.

GALLOWAY, JAMES W., Plant Eng.,
B. Greening Wire Co., Ltd.,
Hamilton, Ontario, Canada.

GLADER, FRANK J., President,
Wm. Glader Machine Works,
Chicago, Illinois.

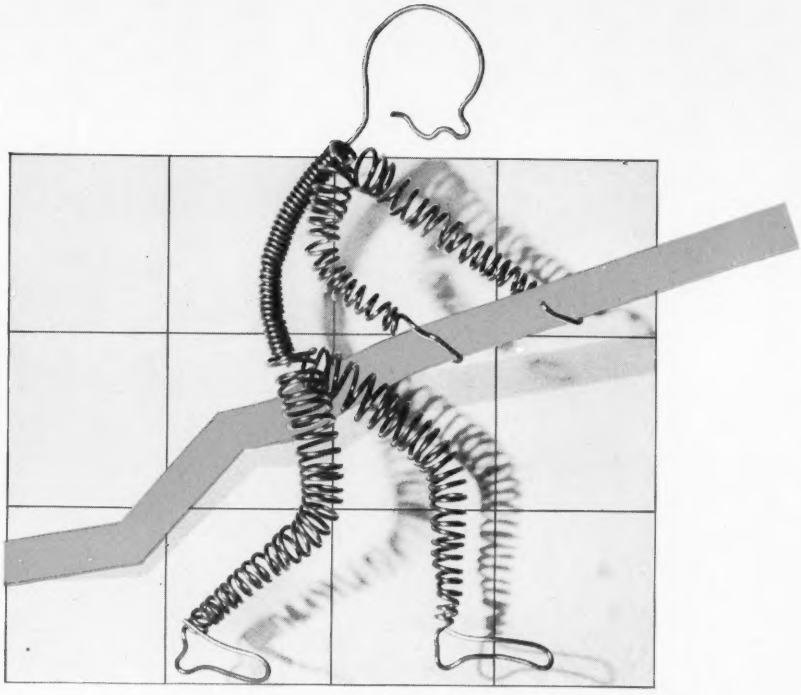
GLEASON, WILLIAM W., Supt.,
Nachman Spring-Filled Corp.,
Chicago, Illinois.

GLEN, A. E., Salesman,
Carboloy Company, Inc.,
Pittsburgh, Pa.

GODFREY, A. H., Dist. Sales Mgr.,
Carboloy Company, Inc.,
Cleveland, Ohio.

GRASSELL, P. W., President,
Wilson Steel & Wire Co.,
Chicago, Illinois.
GREAVES, ROBERT K.,
Ekstrand & Tholand,
Detroit, Michigan.
HAARBAUER, H. W., Supt. Wire Mill,
Townsend Company,
New Brighton, Pa.
HAGGETT, HARRY P., Dist. Sales Mgr.,
Cleveland Tramrail Division,
Cleveland Crane & Engineering Co.,
Willoughby, Ohio.
HAGUE, J. A., Dist. Sales Mgr.,
Pittsburgh Steel Company,
Cleveland, Ohio.
HALL, E. P., Metallurgist,
Kennecott Wire & Cable Co.,
Phillipsdale, Rhode Island.
HALPIN, BERNARD S., Supt.,
Rod & Wire Mills,
Bridgeport Brass Company,
Bridgeport, Conn.
HAMAKER, R. L., Dist. Sales Mgr.,
American Lime & Stone Company,
New York, N. Y.
HAMMERSTEIN, H. K., Chief Engineer,
Broderick & Bascom Rope Co.,
St. Louis, Missouri.
HAMMETT, S. J., Manager,
Morrison Steel & Wire Co., Ltd.,
Vancouver, B. C., Canada.
HANSEN, N. A., Foreman,
Jones & Laughlin Steel Corp.,
Aliquippa, Pa.
HARRISON, C. E., Asst. Sales Mgr.,
The Steel Co. of Canada, Ltd.,
Hamilton, Ontario, Canada.
HARRISON, N. C., Vice-President,
Atlantic Steel Company,
Atlanta, Georgia.
HARTLEY, GEORGE D.,
Worcester, Mass.
HAUGER, F. M., Supt.,
Wilson Steel & Wire Co.,
Chicago, Illinois.
HEASLIP, WM. C., Chief Inspector,
Frost Steel & Wire Co., Ltd.,
Hamilton, Ontario, Canada.
HEYN, HENRY M., Sales Mgr.,
Surface Combustion Corp.,
Toledo, Ohio.
HIRE, HARRY E., Supt.,
Wire & Insulation Division,
General Electric Company,
Fort Wayne, Indiana.
HITCHCOCK, WM. E., President,
Atlantic Wire Company,
Branford, Conn.
HITCHCOCK, WM. E., JR.,
Atlantic Wire Company,
Branford, Conn.
HOLMES, ALVIN W., Engineer,
Indiana Steel & Wire Co.,
Muncie, Indiana.
HOOVER, J. R., Asst. Mgr., Chem. Sales,
The B. F. Goodrich Company,
Akron, Ohio.
HOPE, RALPH B., Supt. Rod & Wire,
Wheeling Steel Corp.,
Portsmouth, Ohio.
HUBBARD, E. J.,
Hubbard Spool Company,
Chicago, Illinois.
HUGHES, CHARLES E., Sales,
Firth-Sterling Steel Co.,
McKeesport, Pa.
HUSSEY, R. M., Supt. Wire Dept.,
Jones & Laughlin Steel Corp.,
Aliquippa, Pa.
INGHAM, T. S., Asst. Sales Mgr.,
American Chemical Paint Co.,
Ambler, Pennsylvania.
JORDAN, D., Foreman,
Buffalo Bolt Company,
No. Tonawanda, New York.
JOHNSON, A. H., Vice-President,
Worcester Wire Works,
Worcester, Mass.
KAVANAUGH, J. F., Mgr. Wire Div.,
C. O. Jelliff Mfg. Corp.,
Southport, Conn.
KEAGLER, H. P., Repr.,
Nukem Products Corp.,
Buffalo, New York.
KENT, M. A., Mfg. Director,
General Cable Corp.,
New York, N. Y.
KENYON, H. G., Supt. Div. A,
General Electric Company,
Pittsfield, Mass.
KENYON, JOHN N., Engineer,
Columbia University,
New York, N. Y.
KINN, L. E., President,
Seneca Wire & Mfg. Co.,
Fostoria, Ohio.
KITSELMAN, HARRY L., Secy.,
Indiana Steel & Wire Co.,
Muncie, Indiana.

(*Please turn to Page 666*)



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that pulls up Production

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Bright . . Tinned
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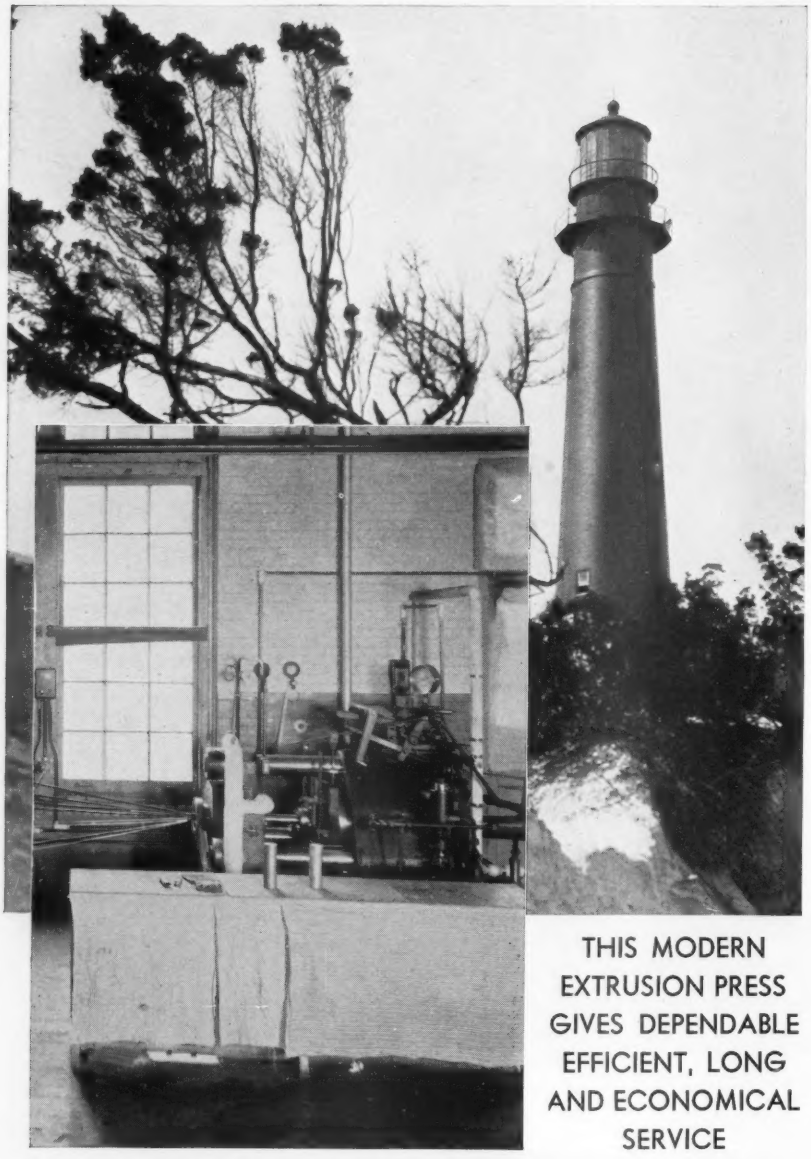

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Wire Association Attendance List—1936 Meeting

(*Continued from Page 665*)

KLEIN, H. C., Sales Eng.,
The B. F. Goodrich Co.,
Akron, Ohio.

KNOLL, S. F.,
Dominion Steel & Coal Corp., Ltd.,
St. John, N. B., Canada.

KNOX, J. D., Asso. Editor,
STEEL,
Cleveland, Ohio.

KOONTZ, RICHARD, Electrical Eng.,
National Standard Company,
Niles, Michigan.

KRUEGER, E. W., Sales,
Keystone Steel & Wire Co.,
Chicago, Illinois.

KUHNLE, L. V., Asst. Mgr. Wire Sales,
Youngstown Sheet & Tube Co.,
Youngstown, Ohio.

LAIDLAW, W., Secy.-Treas.,
Hamilton Wire Products, Ltd.,
Hamilton, Ontario, Canada.

LAUDER, A., Works Mgr.,
Eugene F. Phillips Electrical Works,
Brockville, Canada.

LAWRENCE, J. B., Sales Rep.,
The Ironsides Company,
Columbus, Ohio.

LAWTON, M. P., Foreman,
Jones & Laughlin Steel Corp.,
Aliquippa, Pa.

LENHART, J. C., Supt. Cold Drawn Dept.,
International Nickel Company,
Huntington, West Virginia.

LEWIS, KENNETH B., Consulting Eng.,
Worcester, Mass.

LIGGIE, J. G., General Foreman,
Westinghouse Electric & Mfg. Co.,
East Pittsburgh, Pa.

LONGNECKER, HARRY F., Salesman,
Firth-Sterling Steel Co.,
McKeesport, Pa.

LONGWELL, JAMES R., Chief Eng.,
Carboloy Company, Inc.,
Detroit, Michigan.

McCARTHY, B. L., Metallurgist,
Wickwire Spencer Steel Co.,
Buffalo, New York.

McGOWAN, C. L., Supt. Wire Mills,
Atlantic Steel Company,
Atlanta, Georgia.

McILVRIED, E. J., Chief Eng.,
Vaughn Machinery Company,
Cuyahoga Falls, Ohio.

McKEAN, JOHN R., Asst. Mgr.,
Kennecott Wire & Cable Co.,
Phillipsdale, R. I.

McKUNE, F. B., Supt. O-H.,
Steel Co. of Canada, Ltd.,
Hamilton, Ontario, Canada.

McQUADE, JOHN D., Supt.,
Kemet Laboratories, Inc.,
Cleveland, Ohio.

MACKAY, W. ROY, Chief Inspector,
Bethlehem Steel Company,
Sparrows Point, Md.

MANNING, WM. H., JR.,
John A. Manning Paper Co.,
Troy, New York.

MARTIN, F. L., Dist. Sales Mgr.,
American Lime & Stone Co.,
Pittsburgh, Pa.

MELVILLE, N. F., Mgr. Sales Res.,
Pittsburgh Steel Company,
Pittsburgh, Pa.

MELLOWES, A. W., V.-P. & Gen. Mgr.,
National Lock Washer Co.,
Milwaukee, Wisconsin.

MEYER, F. W., Supt. Wire Mill,
W. S. Tyler Company,
Cleveland, Ohio.

MEYERS, C. W., Dev. Eng.,
American Steel & Wire Co.,
Cleveland, Ohio.

MILLER, R. V., President,
R. H. Miller Co.,
Homer, New York.

MORDICA, JOHN W., Salesman,
Firth-Sterling Steel Co.,
Baltimore, Maryland.

MORGAN, PHILIP, President,
Morgan Construction Co.,
Worcester, Mass.

MORITZ, JOHN A., Vice-President,
Mid-States Steel & Wire Co.,
Crawfordsville, Indiana.

MORRISON, J. R., President,
Morrison Engineering Co., Inc.,
Cleveland, Ohio.

MORROW, J. G., Met. Eng.,
Steel Co. of Canada, Ltd.,
Hamilton, Ontario, Canada.

MUCKLEY, D. S., Supt. Wire Mills,
Colorado Fuel & Iron Corp.,
Pueblo, Colorado.

MYERS, HAROLD A.,
Terkelsen Machine Co.,
Boston, Mass.
NEUHAUS, RICHARD, President,
Nukem Products Corp.,
Buffalo, New York.
NORTON, L. H., Dir. of Purchases,
The National Screw & Mfg. Co.,
Cleveland, Ohio.
NOTVEST, ROBERT, Chief Eng.,
Welding Division,
J. D. Adams Company,
Indianapolis, Indiana.
OBERHAUSER, T. W.,
Laclede Steel Co.,
St. Louis, Missouri.
OLSON, ROBERT V., Vice-President,
Mossberg Pressed Steel Corp.,
Attleboro, Mass.
PARKIN, WM. M., President,
The W. M. Parkin Company,
Pittsburgh, Pa.
PARKIN, WM. M., JR.,
The Wm. M. Parkin Company,
Pittsburgh, Pa.
PASSOLT, H. H., Metallurgist,
Page Steel & Wire Company,
Monessen, Pa.
PEARSON, O. G., Supt. Wire Mill,
Continental Steel Corp.,
Kokomo, Indiana.
PEENE, R. S., Engineer,
Steel Co. of Canada, Ltd.,
Hamilton, Ontario, Canada.
PIERSON, W. D., Secretary,
Waterbury-Farrel Fdry. & Machine Co.,
Waterbury, Connecticut.
PIRK, G. W., Metallurgist,
General Cable Corp.,
Rome, New York.
REEDER, A. M., Met. Engineer,
Jones & Laughlin Steel Corp.,
Pittsburgh, Pa.
RICHARDS, W. A.,
Chicago, Illinois.
RIEDEL, JOSEPH, Foreman,
W. H. Maze Company,
Peru, Illinois.
ROLLE, SIDNEY, Asst. Manager,
U. S. Metals Refining Company,
New York, N. Y.
ROSS, L. C., Sales,
Pittsburgh Steel Co.,
Pittsburgh, Pa.
ROTH, EUGENE, Representative,
Union Wire Die Corp.,
Worcester, Mass.
ROTH, R. B., Pur. Agent,
The Ludlow-Saylor Wire Co.,
St. Louis, Missouri.
SANDELIN, ROBERT W., Metallurgist,
Atlantic Steel Company,
Atlanta, Georgia.
SCHUELER, J. L., Superintendent,
Steel & Wire Division,
Continental Steel Corp.,
Kokomo, Indiana.
SCHULTZ, R. W., Manager,
Metalloys, Inc.,
Williamsport, Pa.
SCHUSLER, F. P., Mgr. Indus. Sales,
Keystone Steel & Wire Co.,
Peoria, Illinois.
SEARLE, H. E.,
International Nickel Co.,
New York, N. Y.
SEYMOUR, L. D., Metallurgist,
Youngstown Sheet & Tube Co.,
Youngstown, Ohio.
SHERMAN, WALDO L., Secy.-Treas.,
John Robertson Company,
Brooklyn, New York.
SIMMONS, R. S., Gen. Metallurgist,
Keystone Steel & Wire Co.,
Peoria, Illinois.
SMITH, VanDORN C., Sales,
Oakite Products, Inc.,
New York, N. Y.
SOMERVILLE, W. E., Engineer,
W. E. Somerville & Co.,
Coal City, Illinois.
SOMMER, A. H., Asst. Supt.,
Keystone Steel & Wire Co.,
Peoria, Illinois.
SPENGEL, R. S.,
WIRE AND WIRE PRODUCTS,
New York, N. Y.
SPOWERS, W. H., JR.,
Consulting Galv. Eng.,
New York, N. Y.
STEVENS, CLYDE A.,
National Association of Manufactures,
New York, N. Y.
STIEFEL, I. B., Mgr., Feeder Div. No. 1,
Westinghouse Elec. & Mfg. Company,
East Pittsburgh, Pa.
STOUT, H. H., JR., Metallurgist,
Phelps-Dodge Copper Products,
Elizabeth, New Jersey.
TATNALL, RODMAN R., Engineer,
Wickwire Spencer Steel Co.,
Worcester, Mass.

(*Please turn to Page 668*)

*CONTINENTAL
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Continental is not content merely to produce superior wire for manufacturing use. Our policy is to engineer the wire to specific jobs—to suit the service of the final product, and to work economically in fabrication. Our metallurgical engineers will study your problems. No obligation, of course.

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WIRE DRAWING

AND THE

COLD WORKING OF STEEL

By

ALASTAIR T. ADAM, A.R.T.C.

PHOTOGRAPHS, DIAGRAMS & TABLES

THE publication of the first edition of "Wire Drawing and the Cold Working of Steel" occurred over ten years ago, but in this age of technical development the progress made is so rapid that such a period is sufficiently lengthy to make any text-book out of date, and in the preparation of the second edition of this valuable work the author has not been so much surprised that much has had to be revised, or rewritten, as that any of the text could be left without modification.

✦ ✦ ✦

THE main scheme of the original edition has been retained with its intention of so presenting the subject that it may be of interest to both the wire manufacturer and the wire user. Some matter has been eliminated, but much has been added, notably an entirely new chapter dealing with typical applications of wire; and although some of the old text remains unaltered, every chapter has been completely revised and several entirely rewritten. The volume has also been re-illustrated with a large number of photographs, diagrams and tables. Thus has been brought fully up to date the author's intention to explain the real nature of cold-worked products, and to show how the physical properties required for a particular process may be obtained.

✦ ✦ ✦

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Wire Association Attendance List— 1936 Meeting

(*Continued from Page 667*)

THOLAND, NILS K. G.,
Ekstrand & Tholand Company,
New York, N. Y.
THOMAS, EARLE H., Superintendent,
George W. Prentiss & Co.,
Holyoke, Mass.
TIDD, HOWARD S., Foreman,
Crucible Steel Company,
Syracuse, New York.
TIMBERLAKE, J. E.,
Jones & Laughlin Steel Corp.,
Pittsburgh, Pa.
TRAUTMAN, O. C., Engineer,
Cleveland Electric Ill. Co.,
Cleveland, Ohio.
TRUETING, H. R., Chem. Engineer,
American Machine & Fdry. Co.,
Brooklyn, New York.
TWIBLE, W. J., Superintendent,
Graham Nail & Wire Products Co.,
Toronto, Ontario, Canada.
TYLER, ELMER S., JR., Representative,
The Atlantic Wire Company,
Branford, Connecticut.
VAUGHAN, CURTIS H., Sales Eng.,
Electric Furnace Company,
Salem, Ohio.
VAUGHN, L. A., President,
The Vaughn Machinery Co.,
Cuyahoga Falls, Ohio.
VOIGTLANDER, CURTIS, Supt. Wire Dept.,
Union Wire Rope Corp.,
Kansas City, Missouri.
WALLACE, L. A., Research Eng.,
Atlantic Steel Company,
Atlanta, Georgia.
WALSH, R. E., Chief Draftsman, Wire Div.,
Waterbury-Farrel Fdry. & Machine Co.,
Waterbury, Connecticut.
WEIKEL, G. A., Sales Representative,
American Chemical Paint Co.,
Chicago, Illinois.
WEISS, J. G., Chief Inspector,
Keystone Steel & Wire Co.,
Peoria, Illinois.
WELLINGS, LIEUT.-COMM. A. J., U. S. N.,
Inspector of Material,
Navy Gun Factory,
Washington, D. C.
WESS, F. A., Wire Mill Supt.,
National Screw & Mfg. Co.,
Cleveland, Ohio.
WESTPHAL, FREDERICK A., Supt.,
Sheffield Steel Corp.,
Kansas City, Missouri.
WEYANT, R. K., Chemist,
Reynolds Wire Company,
Dixon, Illinois.
WHIMPLE, JAMES H.,
W. S. Tyler Company,
Cleveland, Ohio.
WHYTE, R. B., Gen. Supt.,
MacWhyte Company,
Kenosha, Wisconsin.
WICKWIRE, CHESTER F., Vice-President,
Wickwire Brothers,
Cortland, N. Y.
WILLIAMS, ROBERT C., Chief Chemist,
Ironsides Company,
Columbus, Ohio.
WILLIAMS, ROBERT M., Superintendent,
Atlantic Wire Company,
Branford, Conn.
WILLIAMS, R. W., Works Mgr.,
Rome Cable Corp.,
Rome, New York.
WIND, WILLIAM J., Secretary,
Wilbur B. Driver Company,
Newark, New Jersey.
WINKLER, L. H., Metallurgical Eng.,
Bethlehem Steel Company,
Bethlehem, Pa.
WITHINGTON, ROBERT W., President,
American Insulating Machinery Co.,
Philadelphia, Pa.
WOODARD, J. A., Works Mgr.,
Federal Wire & Cable Co.,
Guelph, Ontario, Canada.
WOODHEAD, R. R., Research Eng.,
John A. Manning Paper Co.,
Troy, New York.
ZAPP, A. R., Mgr., Firthaloy Div.,
Firth-Sterling Steel Co.,
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Broden Construction Company New Plant

THE **Broden Construction Company,** manufacturers of wire mill and cold rolling mill equipment, announce the erection of a new plant at 11730 Harvard Avenue, Cleveland, Ohio.

✦ ✦ ✦

THE factory building is 320 feet long by 90 feet wide with a two story office building facing Harvard Avenue. The building is of steel construction with practically all glass sides, giving daylight for operation at all times. For material handling, a three-ton traveling crane runs the whole length of the building.

✦ ✦ ✦

THE Broden Construction Company was incorporated under the laws of Ohio and is about fourteen years old. The president of the company is G. A. Broden whose experience was gained through working in various capacities for American Steel & Wire Company, Gulf States Steel, Jones & Laughlin.

✦ ✦ ✦

MR. F. J. Keller, secretary and treasurer of the company worked for American Steel & Wire Company a good many years as an engineer.

✦ ✦ ✦

Perkin Medal Award

DR. Thomas Midgley, Jr., has been elected to receive the Perkin Medal of the Society of Chemical Industry for 1937. The medal is awarded annually for valuable work in applied chemistry and will be presented this year to Dr. Midgley for his work in the development of anti-knock motor fuels, safe refrigerants, etc. The selection is made by a committee representing the five chemical societies in the United States. The medal will be presented on January 8 at a meeting to be held at The Chemists' Club. Details will be announced later.

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New Construction

GULF STATES STEEL CO., will spend about $2,000,000 on steel mill expansion at Gadsden, Ala., following financial arrangements now under way, according to L. E. Geohegan, vice president and general manager.

✦ ✦ ✦

PROCEEDS of a new bond issue of $7,000,000, and sale of 98,750 new shares of stock will be used to retire existing 5½ per cent debentures, retire the preferred stock, and provide capital.

✦ ✦ ✦

ALTHOUGH $21 in dividend arrearages have been declared on the 20,000 shares of preferred this year, approximately $14 in unpaid accumulated dividends will be paid when the stock is retired. The preferred is callable at $110, plus accumulated dividends. Dec. 31, $4,625,000 of 5½ per cent debentures were outstanding. The additional common stock will be issued from the authorized total of 300,000 shares, 197,500 now outstanding.

✦ ✦ ✦

DETAILS of the plant expansion are now being disclosed. Report was revived recently that Republic Steel Corp. was attempting again to acquire Gulf States Steel, but this is now declared "out of the picture".

✦ ✦ ✦

William Hogenson, Special Representative Republic Steel Corp.

WILLIAM HOGENSON has been named special representative on Toncan Iron enameling stock, according to an announcement by F. H. Ramage, Manager of Sales Promotion, Republic Steel Corp. His work will be in conjunction with that department under the new Product Development Division.

✦ ✦ ✦

MR. HOGENSON comes to Republic with a background of technical and business training gained at the Universities of Michigan and Chicago, and a close association with the Enameling industry through his most recent connection, Chicago Vitreous Enamel Products Co.

STEEL WIRE

By MAURICE BONZEL

Translated and Published by
Kenneth B. Lewis
Consulting Engineer

Price $15.00

A reviewer for "Metal Progress" says:

THIS is the one complete book that discusses the manufacture of wire from the viewpoint of modern physical metallurgy. Hence the price is not excessive. When the purchaser has spent his $15 he has half the scientific library of the industry.

M. Bonzel, the author, is rarely placed. An engineer by education who got his metallurgy under Leon Guillet, he is general manager of the wire mills of Etablissements Bohin. He is fortunate in having an inquiring mind; he respects the traditional lore of the industry but studies each of its practices, and by combined laboratory and plant tests decides what is essential, what is non-essential and harmless, and what is positively detrimental to a good product. Probably he is not unique in this attitude of mind; there are doubtless many other inquiring souls in his industry. He is almost unique, however, in having a disposition plus the permission to share this information with his competitors and the public. . . . .

. . It is to be hoped that the appearance of this work marks the end of an epoch wherein the heat treaters and wire men have been sneering at each other. The metallurgists were taunting the wire men for various illogical rule-of-thumb practices, and the wire men were snickering at the metallurgists for advocating changes that were apparently sound in theory but for occult reasons won't work on wire. Bonzel, the author, and Lewis, his translator, are both men who are broad-minded enough to see both sides of such situations. More power to their clan.

495 pages. 414 illustrations

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New Cleveland Crane Catalog

A VERY interesting description of the origin of the all-welded crane and the method of bridge or girder construction used by the Cleveland Crane and Engineering Company is given in a new catalog just issued. This catalog further discusses various types of their trucks, trolleys, brakes, cages, etc., as well as cranes for various industrial uses. Copies of the catalog can be obtained by addressing the Cleveland Crane and Engineering Company, Wickliffe, Ohio.

✦ ✦ ✦

Statement of Ownership

Statement of ownership, management, circulation, etc., required by the Act of Congress of August 24, 1912 and March 3, 1933, of Wire & Wire Products published monthly at Washington, N. J., for October 1, 1936.

State of New York, County of New York, ss.: Before me, a Notary Public in and for the State and county aforesaid, personally appeared Richard E. Brown, who, having been duly sworn according to law, deposes and says that he is the President of Wire & Wire Products and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Quinn-Brown Publishing Corporation, 17 East 42nd St., N. Y. City; editor, Richard E. Brown, 17 East 42nd St., N. Y. City; managing editor, none; business manager, Richard E. Brown, 17 East 42nd St., N. Y. City.

2. That the owner is: (if owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) Quinn-Brown Publishing Corporation, 17 East 42nd St., New York City, Jennie R. Baker, Hammonton, N. J., and Leta B. Brown, of 17 East 42nd St., New York City.

3. That the known bondholders, mortgagees, and other security holders owning or holding one per cent of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

RICHARD E. BROWN
(President)

Sworn to and subscribed before me this 19th day of September, 1936.

(SEAL) CHARLOTTE FRANKE,
Notary Public.

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With the continuous lead coating of **AMALOY** you can draw stainless steel rod from .28" to .020", with only ONE annealing. This means faster production, lower costs and greater earnings.

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The lead coating of **AMALOY** adheres tenaciously down to the finest strands, a marvelous lubricant; the coating bond with the underlying wire can be convincingly demonstrated as to tenacity by a continuous drawing and redrawing without breaking the continuity of the lead coating.

AMALOY is amazingly different —easily and quickly adapted, extremely flexible and will flow with the longation and reduction throughout the drawing operation. It retards work hardening and therefore increases work life of the material to be drawn.

A Protective Coating for Conductors

A steadily growing number of insulated wire manufacturers use **AMALOY** as a substitute for tin coating on rubber insulated copper conductors, at a fraction of the cost of tin coating and with much better results.

It has the full approval of the Underwriters Laboratories.

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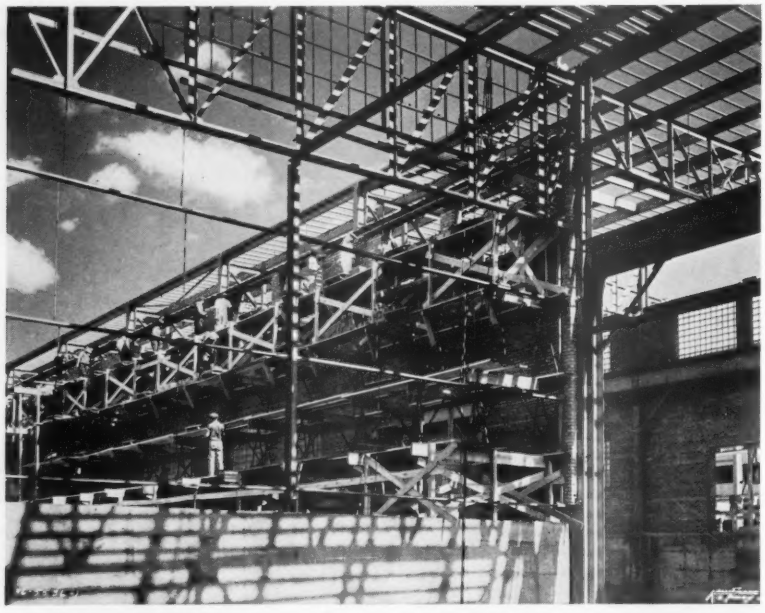
New Wire Mill for Republic Steel Corp.

REPUBLIC STEEL CORP.'s new wire mill is nearing completion at South Chicago in the midst of what was a cattail marsh until four months ago.

✦ ✦ ✦

DESIGNED and constructed by The Austin Co., national organization of industrial engineers and builders, the mill is being built to accommodate high speed crane, monorail and tramrail operations and employs glass block and other new acid-resisting materials in the cleaning house. It has been laid out for closely integrated production of a complete line of wire and wire products.



Glass block panels take the place of windows in the cleaning house of the new Republic Steel Corp. wire mill, now being constructed by The Austin Co. at South Chicago. Sections of the glass block can be most clearly distinguished on the right. Structural T's which will support acid resisting book tile in the roof of the cleaning house can be clearly seen beyond the scaffolding and wall.

✦ ✦ ✦

MORE than 100,000 cubic yards of slag from Republic's slag dump, a quarter mile distant from the wire mill site, have been used for the nine-foot fill underlying 164,500 square feet of concrete floors required in the five sections of this mill. Its concrete foundations rest upon a substrata about 12 feet below floor level and were poured in patented plywood forms. These forms, as well as those for concrete basement tunnels which will house power machinery for the wire mill, were placed in the marsh with the aid of wellpoints, which also protected the concrete from outside moisture during pouring. The concrete was mixed in crawler type pavers and poured over belt conveyors which afforded a reach of 50 feet on either side of narrow preliminary fills that served as runways for the pavers and material trucks at key positions across the site. The slag fill was pulled in around foundation and tunnel walls when curing of the concrete was complete.

✦ ✦ ✦

FOURTEEN hundred tons of steel were required for the project.

✦ ✦ ✦

A MINIMUM thickness of 5/16 inch has been observed in steel in the outside crane runway building which accommodates the rod storage facilities. This section, 100 feet wide and 200 feet long, will be served by a 200-foot railroad siding from which bundles of rods produced in the adjacent rod mill or other Republic steel producing plants will be unloaded by one five-ton crane, with two hooks of two and one-half ton capacity. The crane runways are designed for high speed, with special provision for impact and lateral stresses encountered in quick starting and stopping. The cranes will travel at a rate of 450 feet per

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minute and will lift at a speed of 120 feet per minute. As a safety measure walkways are being built adjacent to the crane girders.

✦ ✦ ✦

THE cleaning department is to be served by cranes of the same type and capacity on a 40-foot span. It has been provided with a steel of ⅜ inch minimum thickness and glass block is being used throughout the walls to provide light without the introduction of sash which would be subject to destruction by the corrosive acids employed in the cleaning and pickling process. Fifty-five hundred glass blocks 7¾ inches square and 3⅞ inches thick have been employed in this L-shaped cleaning section which has a total area of 11,000 square feet and lies between the rod storage and the wire drawing departments. Its roof is made up of book tile, supported by structural Ts, which eliminate the need for reinforcement and are not subject to chemical reactions.

✦ ✦ ✦

THE wire drawing, process storage, galvanizing and fence departments, which extend in a straight line layout over a length of 675 feet, have a clear span of 100 feet.

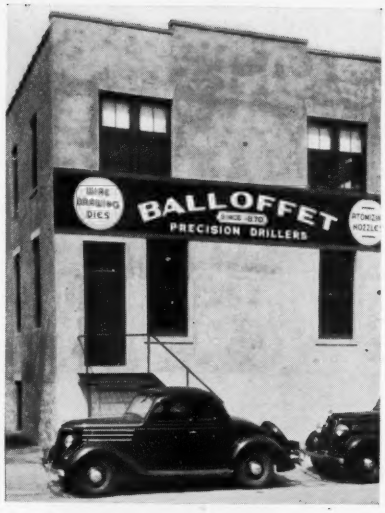
✦ ✦ ✦

AIKEN-TYPE monitors, with two high bays and one low bay in alternating sequence, are used throughout this section and the adjacent nail and warehousing departments. Walkways and ladders are being built over the roof to permit frequent cleaning of the monitors. Truscon Ferro Board 1¾ inches deep, covered by ½-inch of special insulating material, is being employed as roofing in these departments, which cover a total area of 132,000 square feet. Protected metal ventilators, 36 inches by 48 inches, will be installed over the galvanizing room and in the cleaning department to insure an adequate air supply.

✦ ✦ ✦

A SHOP office, 25 feet by 80 feet, is to be located in the process storage area between wire drawing and the galvanizing areas.

(*Please turn to page 674*)



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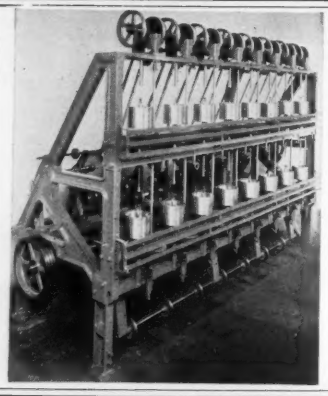

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Adhesion of Galvanized Coatings on Steel Wire

(*Continued from page 656*)

tures, the zinc coating remains intact and adherent, never cracking or peeling. With some care the steel may be broken without severing all of the zinc coating, which then acts as a hinge between the two pieces of steel, demonstrating its extreme ductility and adhesion. In such tests, good adhesion depends on ductility as well as firm bonding of the coating to the steel.

✦ ✦ ✦

A FURTHER advantage of electrogalvanizing is the ability to deposit exceedingly heavy coatings—over three times as heavy as the best applied by the modern hot-dip processes. Such heavy coatings are as smooth, adherent, and ductile as the lighter ones. Precise uniformity and accurate control are inherent in electrogalvanizing. Plants now in operation are producing wire at costs comparable to those of the hot-dip processes.

✦ ✦ ✦

TO the manufacturer, this means that wire products may be fabricated after galvanizing without loss of zinc or exposure of steel. The extremely pure, dense coating is a guarantee of greater resistance to corrosion. Wire with the heavier coatings is certain to receive more attention as its remarkable possibilities and durability are recognized. Electrogalvanizing is, therefore, destined to occupy a prominent place in the wire field within the next few years.

✦ ✦ ✦

New Wire Mill for Republic Steel Corp.

(*Continued from page 673*)

THE loading dock, 275 feet long, will extend alongside the warehousing area and is being built to support special piling trucks weighing 6,000 pounds and carrying a maximum load of 4,000 pounds. It will be served by the Pennsylvania and Indiana Harbor Belt R. R. Truck loading facilities will be provided at a platform at one end of the warehouse.

Exports and Imports of Wire

(*Continued from page 659*)

EXPORTS of iron and steel wood screws during August, 1936 totaled 18,630 gross valued at $3,252. Of this total Cuba took 6,650 gross valued at $688; Philippine Islands 3,033 gross valued at $1,053; United Kingdom 2,392 gross valued at $425; Canada 1,568 gross valued at $378; Uruguay 1,270 gross valued at $105.

✦ ✦ ✦

EXPORTS of brass wood screws during the same period amounted to 10,795 gross valued at $4,024. Of this total Uruguay took 3,295 gross valued at $837; United Kingdom 1,600 gross valued at $928; Panama 1,596 gross valued at $680; Argentina 1,349 gross valued at $405.

✦ ✦ ✦

IMPORTS of wood screws during the same period amounted to 18,584 gross valued at $1,174, of which amount Belgium supplied 8,850 gross valued at $483; Japan 8,150 gross valued at $470; Germany 1,450 gross valued at $179.

✦ ✦ ✦

LIKEWISE, the downward trend continued in **wire cloth and screening imports,** which amounted to 70,520 square feet in August, thereby recording a decline of 20.6 percent from the July total. Outstanding in the supply of the product named were Germany (40,215 square feet), the Netherlands (22,530), and Canada (7,745).

✦ ✦ ✦

IMPORTS of **fourdrinier and other paper-making wire** at 59,206 square feet, however, moved upward sharply (56 percent) to top the July trade, and came in from Germany (36,240), Austria (15,745), France (3,729), and Sweden (3,492).

✦ ✦ ✦

A SLIGHT increase (2.4 percent) was registered in wire heddle receipts (478,000 pieces), which were sent in by Germany (300,000), France (148,000), and Switzerland (30,000).

✦ ✦ ✦

THE import trade in **wire fencing and netting** galvanized before weaving at 134,675 square feet was negligible when compared

(*Please turn to page 676*)

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Exports and Imports of Wire

(*Continued from page 675*)

with receipts in July—3,349,060 square feet. The August total was supplied by Belgium (116,250), The Netherlands (15,750), and Germany (2,675). Of the galvanized after weaving grade, the August aggregate of 183,650 was covered by Germany (147,500), the United Kingdom (12,900), the Netherlands (12,750), and Belgium (10,500), and compared with the July trade of 554,865 square feet.

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Carboloy Prices Drastically Reduced

CARBOLOY COMPANY, INC., Detroit, Michigan, manufacturers of Carboloy Cemented carbide, announce a reduction in prices of Carboloy for tools and blanks effective October 1st, 1936. The new price of Carboloy blanks, for tool use, will be based on 45c per gram in any size. In addition to this substantial reduction in the price of the carbide itself, a further reduction in tool manufacturing labor is also effective on single point tools in quantities of 5 or over on any given tool.

✦ ✦ ✦

ACCORDING to Carboloy Company, Inc., this extreme price reduction will enable users to apply Carboloy tools more freely throughout the plant. It now makes possible the use of Carboloy on many applications previously considered uneconomical, or on the "borderline", due to the former high initial cost of the tools. It will result in further savings on existing Carboloy-tooled production jobs as well as short-run, job-shop applications.

✦ ✦ ✦

THE effect of this price reduction will also be felt in the field of non-cutting, wear-resistant applications such as wear blocks, guides, grinder rests, valve stems and seats, and many machine parts subject to unusual abrasive or corrosive wear. On such applications Carboloy should find extensive application on a more economical basis.

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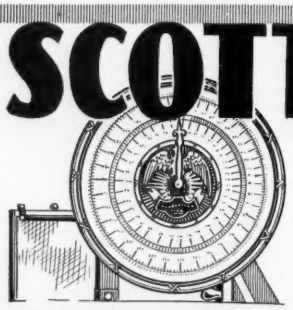

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Booklets

TWO new books, one entitled, "Rolling Mill Bearing Book", and the other "Maintenance and Lubrication of Rolling Mill Bearings", have been issued by the Timken Roller Bearing Company of Canton, Ohio. The "Rolling Mill Bearing Book" is a 64 page booklet, describing Timken bearings of typical applications to various types of mills, etc.

✦ ✦ ✦

IN the back of the book are listed Timken rolling mills, main roll drives and rolling mill pinion stands, giving the name of the company using the equipment.

✦ ✦ ✦

IN the booklet on "Maintenance and Lubrication of Rolling Mill Bearings" is given in detail the recommended practice for assembling Timken Bearings of various types, their repair, adjustment and lubrication.

✦ ✦ ✦

PHOTOGRAPHS illustrate the several types of bearings discussed and diagrams clearly show the system of assembling marking for the four types in common use in rolling mills.

✦ ✦ ✦

RECOMMENDED practice is outlined and a convenient chart shown for keeping track of bearing use and life. There is a full description of the subject of lubrication, outlining the various types of problems which may be encountered and how these should be handled. Tables presenting the type and viscosity of lubricants recommended are included.

✦ ✦ ✦

COPIES of either of these booklets may be secured without cost by writing The Timken Roller Bearing Company, Canton, Ohio.

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Lindberg Engineering Co., Chicago, Ill.
Ross Engineering Corp., New York, N. Y.
Surface Combustion Co., Toledo, O.

GALVANIZING—Special Process
Meaker Company, The, Chicago, Ill.

GEARS—Wire Mill
Farrel-Birmingham Co., Ansonia, Conn.

GRINDERS—Roll
Farrel-Birmingham Co., Ansonia, Conn.
Norton Co., Worcester, Mass.

HANDLING EQUIPMENT—Material
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

HOISTS—Electric Traveling
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

HOISTS—Monorail
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

INHIBITORS
American Chemical Paint Co., Ambler, Pa.
Parkin Co., The Wm., Pittsburgh, Pa.

INSULATION—Cable or Cable Filler
E. W. Twitchell, Inc., Phila., Pa.

LATHES—Die Reaming
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

LIME—Pulverized
Amer. Lime & Stone Co., Bellefonte, Pa.

LININGS—For Acid Tanks
American Hard Rubber Co., New York, N. Y.

LUBRICANTS—Wire Drawing
Amaloy Division of American Machine & Foundry Co., New York, N. Y.
R. H. Miller Co., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.

MACHINERY—Armoring (Cable, Wire Hose)
American Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.
New England Butt Co., Providence, R. I.
John Robertson Co., Brooklyn, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Braiding
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Brazing
Thomson-Judd Wire Machinery Co., Lynn, Mass.

MACHINERY—Bunching
Amer. Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Bundling, Scrap
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cable, Electric
American Insulating Machinery Co., Philadelphia, Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.
New England Butt Co., Providence, R. I.
Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Company, Paterson, N. J.

MACHINERY—Chain Making
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Closing
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Coil Winding
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Coilers
Broden Const. Co., Cleveland, O.
Elevator Supplies Co., Inc., Hoboken, N. J.
Farrel-Birmingham Co., Ansonia, Conn.
Morgan Const. Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Waterbury-Farrel Foundry & Machine Co. Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Copper Wire Drawing and Rolling
Elevator Supplies Co., Inc., Hoboken, N. J.
Farrel-Birmingham Co., Ansonia, Conn.
H. J. Ruesch Machine Co., Newark, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Covering Wire—
Syncro Machine Co., Newark, N. J.

MACHINERY—Cutting
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Ansonia, Conn.
Hallden Machine Co., Thomaston, Conn.
F. B. Shuster Co., New Haven, Conn.
W. A. Schuyler, New York, N. Y.
Sleeper & Hartley, Worcester, Mass.

MACHINERY—Electro - Galvanizing Wire
Meaker Co., The, Chicago, Ill.

MACHINERY—Enameling
American Insulating Mach'y Co., Phila., Pa
Elevator Supplies Co., Inc., Hoboken, N. J.

MACHINERY—Extruding
John Robertson Co., Brooklyn, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Flat Wire
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Forming
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Galvanizing Wire
Broden Construction Co., Cleveland, O.
Meaker Co., The, Chicago, Ill.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Gang Winders
H. J. Ruesch Machine Co., Newark, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., Worcester, Mass.

MACHINERY—Insulating
American Insulating Machinery Co., Phila.
Elevator Supplies Co., Inc., Hoboken, N. J.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Newark, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lead Encasing Presses, etc.
John Robertson Co., Brooklyn, N. Y.

MACHINERY—Lead Stripping
John Robertson Co., Brooklyn, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Magnet Wire
American Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Material Handling
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

MACHINERY—Measuring Wire & Cable
Durant Mfg. Co., Milwaukee, Wis., and Providence, R. I.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Glader, Wm., Machine Works Co., Chicago, Ill.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Panning
American Insulating Machinery Co., Phila.
Elevator Supplies Co., Inc., Hoboken, N. J.

MACHINERY—Pointing
Broden Construction Co., Cleveland, O.
Elevator Supplies Co., Inc., Hoboken, N. J.
H. J. Ruesch Machine Co., Newark, N. J.
E. J. Scudder Foundry & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Rod Mill
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Ansonia, Conn.
Morgan Const. Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
W. A. Schuyler, New York, N. Y.

MACHINERY—Rolling Mill
Broden Construction Co., Cleveland, O.
Elevator Supplies Co., Inc., Hoboken, N. J.
Farrel-Birmingham Co., Ansonia, Conn.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Rubber Strip Covering
Farrel-Birmingham Co., Ansonia, Conn.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Rubber Tubing and Straining
Farrel-Birmingham Co., Ansonia, Conn.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Screw Wire
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Special
American Insulating Mach'y Co., Phila. Pa.
Broden Construction Co., Cleveland, O.
Elevator Supplies Co., Inc., Hoboken, N. J.
H. J. Ruesch Machine Co., Newark, N. J.
E. J. Scudder Foundry and Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Special—Combination Machine for Drawing, Cutting-to-length, Straightening and Reeling Bars from Coil in One Operation (Shumag Type)—
W. A. Schuyler, New York, N. Y.

MACHINERY—Spooling
American Insulating Machinery Co., Phila.
Elevator Supplies Co., Inc., Hoboken, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.

BUYERS' GUIDE, Continued

Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spring Making
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening
Broden Construction Co., Cleveland, O.
Hallden Machine Co., Thomaston, Conn.
H. J. Ruesch Machine Co., Newark, N. J.
W. A. Schuyler, New York, N. Y.
F. B. Shuster, New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Stranding
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Strip Steel
Broden Const. Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.

MACHINERY—Swaging
Elevator Supplies Co., Inc., Hoboken, N. J.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Worcester, Mass.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Taping
Amer. Insulating Mach. Co., Phila., Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Testing Wire
Henry L. Scott Co., Providence, R. I.

MACHINERY—Tinsel Rolling Mills
Amer. Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.

MACHINERY—Trolley Wire
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill
H. J. Ruesch Machine Co., Newark, N. J.

MACHINERY—Welding Wire
Micro Products Co., Chicago, Ill.
F. B. Shuster Co., New Haven, Conn.
Thomson-Judd Wire Machinery Co., Lynn, Mass.

MACHINERY—Winding
American Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Drawing
American Insulating Machinery Co., Phila.
Broden Const. Co., Cleveland, Ohio.
Elevator Supplies Co., Inc., Hoboken, N. J.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
E. J. Scudder Foundry & Machine Co., Trenton, N. J.
W. A. Schuyler, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Wire Rope
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Company, Paterson, N. J.

MACHINERY—Wire Tinning
American Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.

MACHINERY—Wrapping Wire
W. A. Schuyler, New York, N. Y.

MATERIAL HANDLING EQUIPMENT—
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

MONORAIL SYSTEMS—
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

NICKEL SILVER AND PHOSPHOR BRONZE—Rod, Wire and Strip
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

OVENS—Annealing or Drying
Lindberg Engineering Co., Chicago, Ill.
Ross Engineering Corp., New York, N. Y.

PAPER—Insulating
Manning, John A., Paper Co., Inc., Troy, N. Y.
E. W. Twitchell, Inc., Phila., Pa.

PATENT ATTORNEYS—
Lancaster, Allwine and Rommel, Washington, D. C.

PICKLING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Parkin Co., The Wm., Pittsburgh, Pa.

PICKLING—Tank Linings
American Hard Rubber Co., New York, N. Y.

POTS—Annealing, Case Hardening and Tempering
Lindberg Engineering Co., Chicago, Ill.

POTS—Lead Melting
Farrel-Birmingham Co., Ansonia, Conn.
John Robertson Co., Brooklyn, N. Y.

PRESSES—Hydraulic and Mechanical
Farrel-Birmingham Co., Ansonia, Conn.
John Robertson Co., Brooklyn, N. Y.

PRESSES—Lead
John Robertson Co., Brooklyn, N. Y.

PULLERS—Wire
E. J. Scudder Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

PUMPS—Hydraulic
John Robertson Co., Brooklyn, N. Y.

REEL AND TENSION STAND—
Sleeper & Hartley, Inc., Worcester, Mass.

REEL CRUTCHES
Watson Machine Co., Paterson, N. J.

REELS—Annealing and Stranding
Mossberg Pressed Steel Corp., Attleboro, Mass.

REELS—Impregnating
Mossberg Pressed Steel Corp., Attleboro, Mass.

REELS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.

REFRACTORIES—High Temperature
Norton Co., Worcester, Mass.

ROD BAKERS—
Morrison Engineering Co., Cleveland, O.

RODS—Wire—Non Ferrous
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.
Seymour Mfg. Co., Seymour, Conn.

RODS—Wire—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Laclede Steel Co., St. Louis, Mo.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Co., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

ROLLS—
Farrel-Birmingham Co., Ansonia, Conn.

RUST PROOF COMPOUND
American Lanolin Co., Lawrence, Mass.

SHEET—Steel
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Republic Steel Co., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, O.

SOAPS—Wire Drawing
Amaloy Division of American Machine & Foundry Co., New York, N. Y.
R. H. Miller Co., Homer, N. Y.

SPOOLS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.

STRIP—Brass, Zinc and Non Ferrous
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.
Seymour Mfg. Co., Seymour, Conn.

STRIP—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Laclede Steel Co., St. Louis, Mo.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Co., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.

TANKS—Compound
Watson Machine Co., Paterson, N. J.

TESTERS—Wire
Henry L. Scott Co., Providence, R. I.

TRAMRAIL SYSTEMS—
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

TREADS—Safety
Norton Co., Worcester, Mass.

TRUCKS
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

TUBE BENDERS AND FORMERS
H. J. Ruesch Machine Co., Newark, N. J.

VALVES AND FITTINGS—Acid Proof
Duriron Co., The, Dayton, O.

VULCANIZERS
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS
American Insulating Mach'y Co., Phila., Pa.

WIRE—Cold Heading
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Laclede Steel Co., St. Louis, Mo.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corp., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Electric
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

WIRE—Enameled For Coils
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Manufacturers
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Co., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Laclede Steel Co., St. Louis, Mo.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Co., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, Ohio

WIRE—Nickel Silver and Phosphor Bronze
Hudson Wire Company, Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

WIRE—Non Ferrous to Specification For Special Purposes
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Spring
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel and Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Co., Youngstown, O.
Seymour Mfg. Co., Seymour, Conn.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE—Steel—Also Coppered Steel—Also Galvanized Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Laclede Steel Co., St. Louis, Mo.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Co., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE AND STRIP—Brass, Zinc
Platt Bros. & Co., The, Waterbury, Conn.

This is a carefully classified index of concerns who specialize in this industry and who advertise regularly in WIRE & WIRE PRODUCTS. Please mention WIRE when writing to these firms.

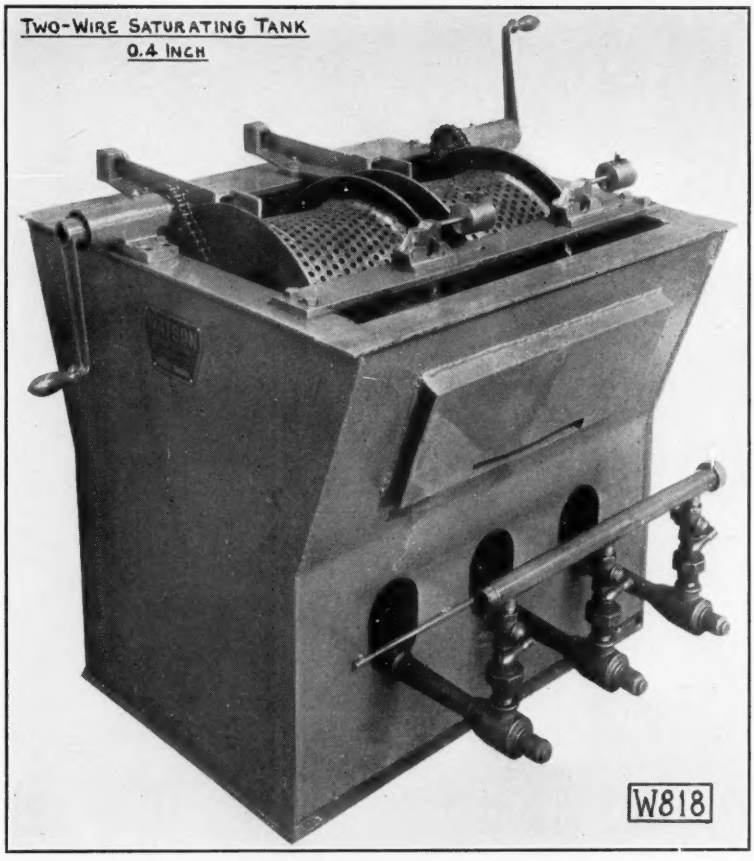
THE WATSON MACHINE COMPANY

ESTABLISHED 1845

PATERSON, NEW JERSEY, U. S. A.

ELECTRICAL WIRE AND CABLE, WIRE ROPE AND CORDAGE MACHINERY

SINGLE-DRUM GAS-FIRED SATURATING TANKS



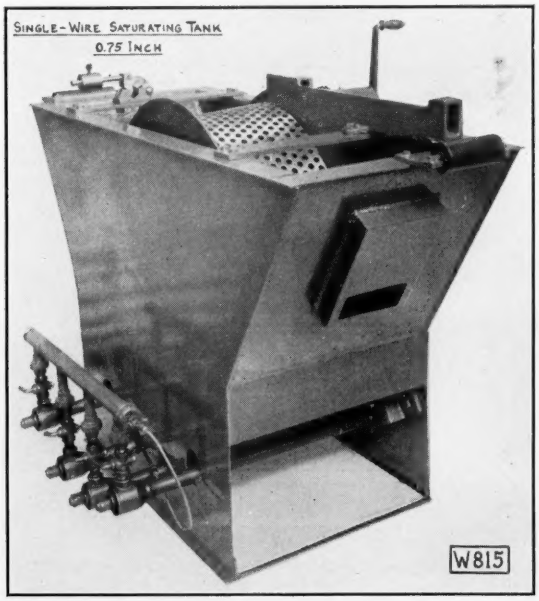
For one or two wires, with or without Wax Pre-heat Chamber.

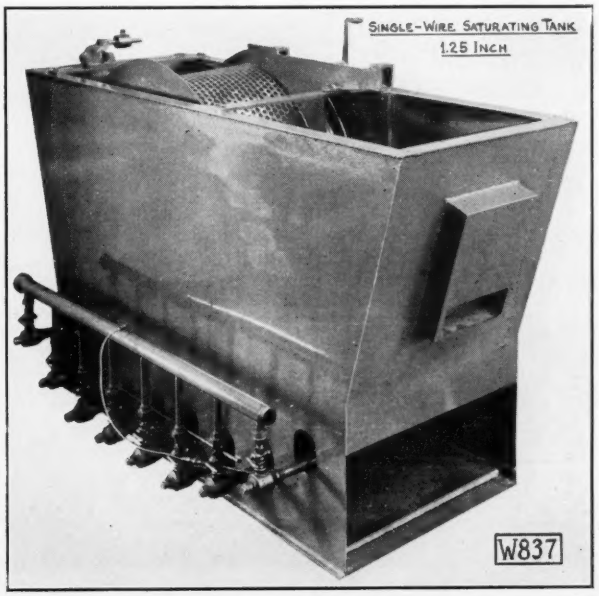
Atmospheric Gas Burners of ample capacity, with gas and air adjustment and shut-off cock on each burner.

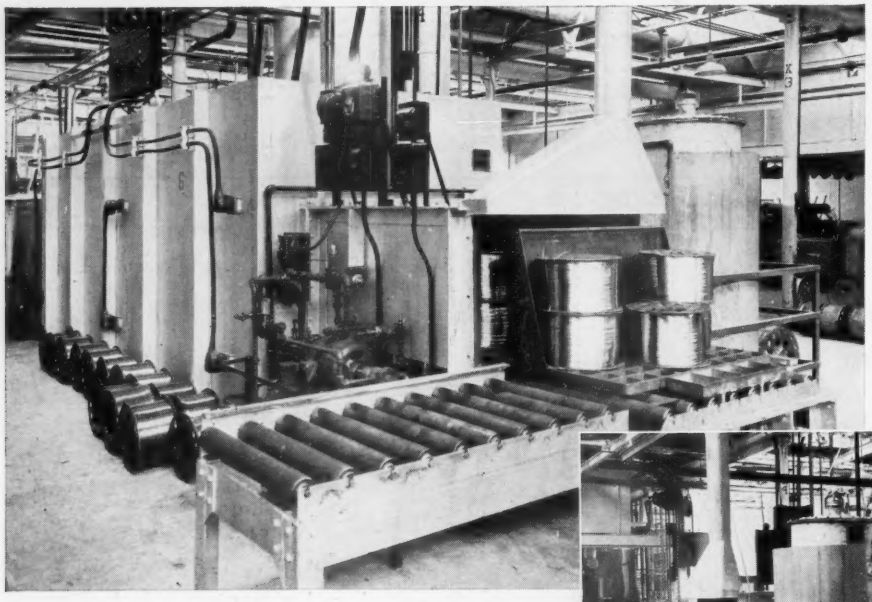
Temperature Controller in main gas feed.

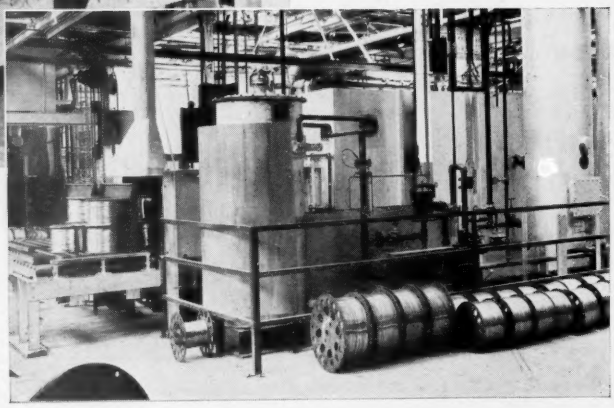
Asbestos - insulated walls and fire box bottom.

Letoffs, Takeups, etc., on separate bulletins.









Continuous
Special Atmosphere Furnace

Bright Annealing Copper Wire

Capacity 36,000 lbs. per Day

Copper wire from 42 gauge up to heavy sizes is bright annealed uniformly, economically and continuously in the special atmosphere, recuperative, pusher type furnace shown above.

Coiled wire, as well as wire on small spools and large reels, is successfully handled in this equipment. No water seals or vapor of any kind is used, thus staining is entirely eliminated and no drying necessary. The wire is discharged from the furnace uniformly annealed, absolutely bright and dry, ready for shipping, further processing or fabricating.

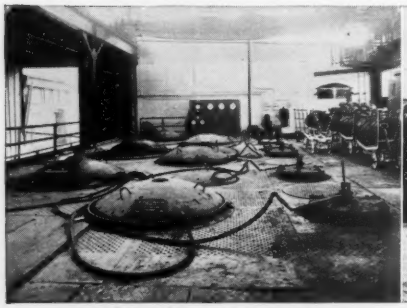
The above is one of several types of electric and fuel-fired furnaces we have developed and built for the wire industry—both ferrous and non-ferrous.

Other recent installations include furnaces for clean annealing brass wire, improved pit type furnaces for normalizing and bright annealing steel wire in coils, as well as furnaces for scale-free hardening bolts, springs, etc., billet heating, bright annealing, carburizing, copper brazing and other heating and heat treating processes.

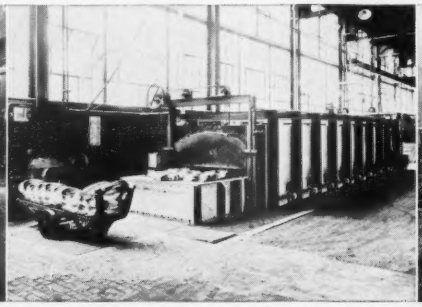
If you are interested in improving the quality of your anneal or heat treatment, increasing production or are contemplating any changes or additions to your furnace equipment, our engineers will be glad to work with you. We specialize on building production furnaces to fit the customer's specific requirements.

The Electric Furnace Co., Salem, O.

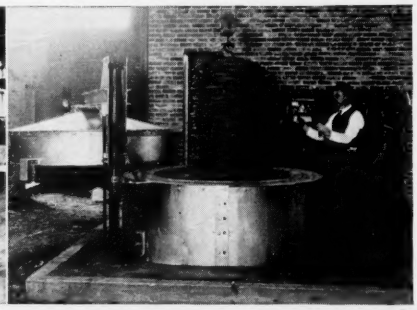
We Build the Furnace to Fit Your Job — For Oil, Gas or Electric Heat.



Annealing Wire and Normalizing Rod.



Clean Annealing Brass Wire.



Annealing Special Alloy Wire.